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SOCKEYE SALMON SMOLT ABUNDANCE, TIMING, AND GROWTH CHARACTERISTICS FOR RED, AKALURA, UPPER STATION, AND FRAZER LAKES, 1993

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INTRODUCTION

In the Kodiak Management Area (KMA; Figure 1), sockeye salmon *Oncorhynchus nerka* spawn in about 40 systems (Brennan et al. 1993). Most of these systems are within the Kodiak National Wildlife Refuge, 1.9 million acres set aside in 1941 to preserve brown bear feeding and reproduction. Sockeye salmon are an important food resource for brown bear and an economic mainstay of the KMA commercial salmon fishery. The commercial fishery average harvest (1990-1993) of 4.9 million sockeye salmon is worth about 29.3 million dollars (Brennan et al. 1993). The Kodiak salmon fleet consists of about 610 permit holders; 61% are Kodiak Island residents inclusive of six Native villages (K. Iverson, Alaska Department of Fish and Game, Commercial Fisheries Entry Commission, personal communication). The subsistence sockeye fishery is also important, averaging 19,000 fish annually (1988-1992; Brennan et al. 1993).

In 1989, crude oil from the M/V Exxon Valdez spill in Prince William Sound entered the Gulf of Alaska, subsequently contaminating all of the traditional KMA salmon harvest areas (Barrett and Monkiewicz 1989). As a consequence of curtailed fisheries, sockeye salmon escapement goals were exceeded at several systems during 1989, which included Afognak River, Akalura Creek, Dog Salmon River (Frazer Lake), and Ayakulik River (Red Lake).

The largest 1989 escapement excesses occurred at Red and Akalura, and there are concerns that sockeye productivity in these lakes may be damaged as a result. Previous studies have documented that too many juvenile sockeye salmon fry in a rearing limited system can alter zooplankton biomass and species and size composition, thereby lowering sockeye survival (Kyle et al. 1988; and Koenings and Kyle 1991). These changes can reduce over-winter sockeye fry survival, extend freshwater rearing for an additional year, and affect multiple brood years.

In 1990, sockeye salmon smolt studies were initiated at Red, Akalura, and Upper Station (control) Lakes to measure responses from the 1989 escapement event (Figure 2; Barrett et al. 1993). This report documents the fourth (1993) year of the study and includes the 1993 sockeye smolt work at Frazer Lake, conducted under non-oil related funding. Frazer Lake is included as an alternate control for the Akalura and Red Lakes damage assessment. Unlike Upper Station, Frazer Lake has a single sockeye run and does not produce age 0. smolt. However, Frazer Lake as a control is not without problem. The 1989 Frazer Lake escapement at 360,373 fish was 80% above the upper escapement goal of 200,000, and lake fertilization has occurred for five years (1988-1992), to correct for pre-1986 overescapements.

OBJECTIVES

1. Estimate the total number of outmigrant sockeye smolt by age class for study lakes Red, Akalura, Upper Station, and Frazer in 1993.

2. Estimate sockeye smolt timing and growth characteristics (length, weight, and condition factor) by age class for each study lake in 1993.

3. Estimate the seasonal use of Red Lake nearshore areas by young-of-year sockeye fry (age 0.) in 1993.

METHODS

Smolt Traps and Site Locations

At Red Lake, from 04 May through 30 June, two Canadian fan traps (Ginetz 1977) were operated 1.6 km downstream of the lake outlet where water depth averaged about 0.4 m and velocity exceeded 0.3 m/sec. The traps were placed parallel to each other in the stream about 2 m and 6 m, respectively off the west bank. From 04 May through 24 May, the traps were equipped with perforated aluminum plate leads (2 m height, 1 m width, 4.8 mm dia. holes) angled at 30 degrees upstream. Post 24 May, leads were not used due to excessive algae outflow from the lake. The nearshore trap was fitted with a single live box, while the other had two live boxes. Live box dimensions were about 1.5 m long, 1.0 m width, and 0.8 m high.

At Akalura and Upper Station, 5.6 km and 1.2 km downstream of the respective lake outlets, a single Canadian fan trap equipped with a live box (1.5 m length, 1 m width, and 0.8 m height) was operated. The Akalura trap was operated from 03 May through 20 June, while Upper Station functioned from 04 May through 09 August. The traps were located in waters where stream depth was >0.4 m and velocity >0.3 m/sec. Throughout the season, a lead was used on the Upper Station trap and at Akalura from 28 May through 20 June to improve trap catch efficiency. Both the Akalura and Upper Station trap leads were about the same dimension and configuration as those used with the Red Lake traps.

At Frazer Lake, an inclined plane trap as described by Mesiar (1986) was operated from 06 May through 20 June, 1.3 km downstream of the lake outlet, 10 m below the falls at the Frazer Lake fishpass, and about 5 m from the north bank. At the site, average water depth was 0.9 m and velocity $>$ 0.3 m/sec. The inclined plane trap was not equipped with a lead. A concrete trap, on the south end of the fishpass entrance below the falls, was operated from 06 May through 14 June and was used with a 9 m lead. Further concrete trap description is in Barrett (1989).

Shields constructed of wood or aluminum were installed on the traps to reduce headlamp and lantern light in the trap entrances.

Smolt Enumeration

At all locations during the evening, traps were routinely checked for catch and proper operation several times each hour using battery powered headlamps and gasoline lanterns. During daylight hours, the traps were monitored less. At each check, the catch was enumerated by species and released. An exception was that some catch was routinely held for sampling, as described later. Species identification was made by visual examination of external characteristics (McConnell and Snyder 1972; Trautman 1973).

Trap catch numbers by species were determined by direct count using a dip net and hand tally counters. The exception was that a catch-weight method was implemented when catch rates exceeded the crew's ability to hand tally. For this method, the catch was transferred by dip net to a small wetted mesh basket attached to a weight scale suspended over the stream by an A-frame support. Each dip net load was individually weighed. After weighing, the catch was quickly released into the stream. About every tenth dip net load was sampled to determine species count by weight. This entailed transferring a dip net load to a 19 L plastic bucket filled with water, counting the sample by species while spilling the catch into another 19 L bucket, and transfering the contents of the second bucket into the hanging basket for weighing. All catch weights were recorded to the nearest 0.1 kg.

All catch data were recorded by sampling day. A sampling day extended from noon to noon and was identified by the calendar day of the noon to midnight period.

Age, Weight, and Length Sampling

At each location, about 70 sockeye smolt were sampled daily for age, length, and weight five days a week, subject to smolt availablity. To prevent bias, live box contents were stirred immediately preceding any removal. Each sampled fish was anesthetized with MS-222. A scale smear from the preferred area (INPFC 1963) was removed and mounted on a standard microscope slide for ageing; smolt weight was recorded to the nearest 0.1 g using a Dial-A-Gram scale, and tip-of-snout to fork-of-tail length (TL) was recorded to the nearest 1 mm. After sampling, all smolt were revived and released to the stream below each site. Ageing of scales was conducted using a 42X lens microfiche reader. All ages were recorded in European notation (Koo 1962).

Trap Efficiency Tests

Trap efficiency was determined at least weekly subject to smolt availability. At all sites except Frazer, about 500 smolt were dyed and released about 1 km upstream in relatively low velocity water (<0.5 m/sec). At Frazer, the number released was about 1,000. Smolt used for tests of trap efficiency were collected from the trap(s) within three days and usually within one day of each test. An instream covered live box with perforated sides was used to hold the smolt prior to upstream transport. Transport was performed using backpacks and 19 L plastic buckets equipped with battery powered aerators. At the release sites, smolt were placed into instream live boxes and held for about 30 minutes before transfer into a continuously oxygenated dye solution of 1.9 g Bismark Brown Y dye to 5.7 L of water for another 30 minutes. After dyeing, the smolt were held for 60 minutes in an instream perforated livebox with lid, and then, placed in water filled 19 L buckets for release across the stream channel. At each step in the process, the smolt were counted, and those judged to be behaving abnormally were destroyed.

Following the release of dyed fish, the traps were checked for three or more days for recoveries. All recaptures were recorded separately from the unmarked fish catch and were not included in the daily trap catch totals.

Littoral Zone Seining

At Red Lake, four shoal sites which were selected in 1992, were sampled once weekly using a beach seine 15 m in length, 2 m deep, and about 6 mm stretch mesh. The catch was counted by species, and TL (mm) was recorded for sockeye salmon, Dolly Varden (*Salvelinus malma)*, coho salmon (*Oncorhynchus kisutch*), and rainbow trout (*Oncorhynchus mykiss*). Water temperature (C) was taken during each sampling event.

Climate Observations

At the trap locations, air and stream temperatures (C), stream height (cm), percent cloud cover, and wind velocity and direction were recorded at about 1800 h daily.

DATA ANALYSIS

For obtaining smolt numbers from data collected from the catch weight method (when employed) the following relationship was used:

$$\hat{C}=\frac{ac}{b}, \tag{1}$$

where a is the grand smolt weight total less basket weight; b is a subsample of total weight less basket weight; and c is the count of smolt from subsampled baskets.

In deriving trap efficiency from the mark-recapture and trap catch data the formula used was:

$$\hat{e}=\sum_{i=1}^{k}\frac{d_i}{D_i} \tag{2}$$

where d_i is the number of marked fish recaptured over (k) successive nights after release, and D_i is the number of marked fish released on day i. Since mark-recapture trap efficiencies were derived on a weekly basis, we assumed there was heterogeneity between weekly trials as was found in previous years (Barrett et al. 1993). Therefore, we employed linear interpolation between weekly trap efficiency values to obtain daily estimates. Rawson (1984) reported statistical models for treating sockeye smolt mark-recapture data derived on a daily basis with population estimates generated by:

$$\hat{N}_i=n_i[\frac{D_i}{d_i}+\frac{(D_i-d_i)}{d^2}]=\frac{n_i}{d_i}[D_i+D_i-\frac{d_i}{d_i}]=n_i\frac{D_i}{d_i}[1+D_i-\frac{d_i}{D_i}d_i];$$

with variance

$$Var[\hat{N}_i] = n_i(n_i+d_i)\ D_i(D_i-d_i)/d_i^3.$$

The overall annual smolt outmigration for a particular system was estimated by:

$$\hat{N} = \sum_{i=1}^{k} \hat{N}_i; \tag{3}$$

with the overall variance estimated by:

$$Var[\hat{N}] = \sum_{i=1}^{k} Var[\hat{N}_i] \tag{4}$$

where:

i) N_i = Total population of smolt outmigrating on day i;
ii) n_i = Number of marked fish captured in traps during day i;
iii) N = Total smolt population outmigrating over k days.

The (1-α) confidence intervals for the smolt population estimates were derived assuming a normal distribution (Rawson 1984).

Condition factor for each smolt sampled was determined using:

$$K = \frac{W*10^5}{L^3} \tag{5}$$

where W = weight in grams and L = length (tip-of-snout to fork-of-tail) in millimeters.

RESULTS

The 1993 daily sockeye smolt trap catch numbers and trap efficiency estimates for Red, Akalura, Upper Station, and Frazer Lakes are provided in Appendix A. The daily smolt population estimates and associated 95% confidence intervals are listed in Appendix B, while the population estimates assigned by age are provided in Appendix C.

For these systems, the 1993 sockeye smolt abundance numbers by brood year (BR) and age are presented in Tables 1-4 along with the 1990 through 1992 data for comparison. A similar summary for average smolt length and weight data is provided in Tables 5-6. Appendix D provides mean smolt length, weight, and condition factor by age and date for 1993.

The 1993 Red Lake littoral zone seine catch data along with the 1992 data are presented in Appendix E.

The 1993 climatological data collected are in Appendix F.

DISCUSSION

Red Lake

In 1993, an estimated 583,985 sockeye smolt migrated from Red Lake, about 25% less than the 1990-92 average (Table 1). Age-1. smolt from the 1991 BR were most abundant contributing 52% to the total outmigration followed by age-2. smolt at 33% (1990 BR), and age-3. at 15% (1989 BR; Figure 3). While fewer smolt than average outmigrated in 1993, ages-1. and -3. numbers were greater than for the previous three years (1990-92; Barrett et al. 1993).

Average length and weight of all smolt in 1993 were with the range observed for the 1990-92 period (Tables 5-6).

The outmigrant timing of ages-2. and -3. smolt were similar in 1993 with both reaching peak abundance in the last week of May (Figure 4; Appendix C.1). Age-1. smolt migrated later with the peak occurring in the second week of June.

In 1993, use of the littoral area by age-0. sockeye fry was about double that observed in 1992 based on seine catch at four sites (Figure 5; Appendix E.1). Additionally, the same abundance trend was observed for stickleback. In both years, most of the sockeye fry and stickleback were found at the seine site at the northwest end of Red Lake (Appendix G). It is likely that the sockeye fry catch at this location was influenced by nearby Connecticut Creek, the major sockeye spawning tributary.

Age-0. sockeye fry use of the Red Lake littoral areas occurred earlier in 1993 than in 1992 (Figure 5). The 1993 peak catch was in late May, while in 1992 the peak was three or more weeks later. In both years, sockeye fry in the littoral zone averaged about 35 mm length during May and June (Appendix E.2). However, since age-0. sockeye fry usually begin pelagic rearing between 35-40 mm length (Barrett 1989), average fry length may not be a suitable indicator of nearshore rearing conditions. Average length of littoral area rearing fry would therefore be expected to remain fairly stable because of continual emigration.

The 1993 Red Lake outmigration numbers complete the 1989 BR. The total number of sockeye smolt produced from the 0.8 million 1989 escapement is an estimated 1.6 million (Table 1). This represents about 4X more smolt than estimated for the 1988 BR and 7X more than for the 1990 BR, based upon ages-1. and -2. smolt numbers. While the Red Lake smolt estimates should be considered relative index values, at least for BR's 1987 and 1988, it is apparent that the 1990 BR has produced fewer ages-1. and -2. smolt collectively, than BR's 1988 and 1989.

The 1994 preliminary Red Lake sockeye forecast is for a 425,000 fish run (Appendix H). Most (70%) of the run is expected to be age 2.2 fish from the 1989 escapement of 0.8 million fish; if the age 2.2 component is much below the projection, minimal fishing time in the Inner and Outer Ayakulik Sections (ADF&G 1993), the terminal commercial harvest area, can be expected. The major concern for the 1994 fishery will be to ensure that the escapement goal of 200,000 to 300,000 is met.

Based on the relatively low index of ages-1. and -2. smolt from the 1990 BR and similarly few age-1. smolt from the 1991 BR, the 1995 run may also be below average. This scenario may also lead to problems in 1995 for achieving the upper end of the escapement goal.

Akalura

At Aklaura, the 1993 smolt outmigration was an estimated 88,873 fish, about 4X lower than the 1990-92 average of 325,972 (Table 2). Age-2. smolt were the most abundant comprising 82% (1990 BR) of the estimate, followed by age-3. at 14% (1989 BR), and age-1. at 4% (1991 BR) (Figure 6; Appendix C.2). While age-3. smolt represented only 14%, numerically they were more abundant than in the 1990-92 outmigrations.

The ages-2. and -3. smolt length and weight averages for 1993 were within the range of averages for 1990-92 (Tables 5-6).

In 1993, age-1. smolt averaged about 14 mm smaller and weighed 1.7 g less than age-1. smolt in the 1990-92 migrations (Tables 5-6). The 1993 age-1. smolt scale pattern was atypical as there was no annulus present (Figure 7).

The assignment of age-1. to sampled fish that were absent a freshwater annulus was based on several factors. First, because age-0. fish were not present in the 1990 through 1992 outmigrant samples, with exception of one sampled fish in 1992. Second, no fish in the entire 1,160 fish age sample for 1993 had a scale pattern of less than two annuli. Third, age-1. smolt have been a component of the outmigration for the last three years (1990-1992). Fourth, age-3. smolt abundance has increased each year since 1990 which is an indication of a less than optimum freshwater rearing conditions. Lastly, the potential for Akalura or any other Kodiak system producing age-0. smolt in late May is improbable.

Scales from the 1993 age-1. smolt showed about 3-5 circuli per scale (Figure 7). For comparative purposes, typical 1993 ages -2. and -3. smolt and 1992 age-1. scale patterns have been provided (Figure 8). The absence of a scale annuli was likely due to starvation extending beyond the 1992-93 winter into the 1993 spring. As reported by Bilton and Robins (1971), annuli development occurs after food depravation and not during starvation periods. It is unlikely that the BR 1991 young-of-year fish did not reach scale development stage until after the 1992-93 winter. Rudimentary sockeye scale development occurs at about 38 mm length (Clutter and Whitesel 1956), and smaller fish would probably have insufficient fat reserves to

successfully over-winter. The ages-2. and -3. smolt scales had minimal if any plus growth which tends to suggest that the 3-5 circuli present on the age-1. smolt scales were developed from the 1992 summer and fall rearing periods not during spring growth in 1993.

In 1993, most of the sockeye smolt migrated in late May. Peak abundance for ages-1. and -3. smolt occurred in the third week of May, and for age-2. smolt in the fourth week of May (Figure 9).

Based on 1990-93 smolt outmigrant estimates, the 1987 and 1988 BR's produced about twice the number of smolt as the 1989 BR (Table 2). The 1990 BR as measured by ages-1. and -2. smolt, has produced about 50% less than the 1989 BR. Overall, the Akalura system has shown a steady decline in smolt production and a shift in age composition to fewer age-1. and more age-3.'s. However, age-2. smolt have remained dominant.

Although a formal forecast has not been prepared, the Akalura system can be expected to have a 1994 run insufficient to meet the 40,000-60,000 escapement goal. Even more probable, due to the few smolt produced from the 1989 and 1990 BRs, the 1995 run will likely be lower. In both years, complete closure of the Inner and Outer Akalura Sections (ADF&G 1993), the terminal harvest area, can be anticipated.

Upper Station

The 1993 smolt outmigration from Upper Station was estimated at 3,462,058, which was about 16% lower than the 1990-92 average (Table 3). As with previous years (1990-92), age-0. smolt dominated (Figure 10).

Smolt mean lengths measured during 1993 were larger than for all previous years except for age-1. fish, which were about average (Tables 5-6). Mean weights for all age classes were also larger except for age-1. fish.

The peak of the age-2. smolt outmigration occurred during 17-23 June (Figure 11). Age-1. smolt outmigrated in a bimodal pattern with the first peak occurring during 31 May through 6 June and the second about 14-20 June. Age-0. smolt were the latest outmigrants relative to other age classes with a peak during 5-11 July.

As determined from the 1990-93 outmigrant estimates, the 1988-90 BR production of ages-1. and -2. smolt has been relatively stable, averaging collectively about 0.5 million (Table 3). The 1991 BR appears strong having produced an estimated 0.2 million more smolt than the 1990 BR. While ages-1. and -2. smolt are common to both the early and late Upper Station runs, age-0. smolt are exclusive to the late run (Roche 1992). For BR's 1989-1992, age-0. smolt numbers have averaged 3.0 million, ranging from 1.9 to 5.5 million.

The 1994 preliminary Upper Station forecast is for a 120,000 fish early run and a 425,000 fish late run (Appendix H).

Frazer Lake

The 1993 Frazer Lake outmigration was estimated at 9.7 million smolt, which was about 3.3 million greater than for 1991 and 1992 (Table 4). Ages-2. (51%) and -3. (47%) smolt dominated the outmigration which was different than in the previous two years. In comparison, 1991 ages-1. (40%) and -2. (59%) smolt represented most of the total migration, whereas in 1992, smolt were almost exclusively age-2. (89%; Figure 12).

In 1993, age-1. smolt averaged about 90 mm which was slightly larger than the 1990-92 average (Tables 5-6). Age-2. smolt were also larger, and age-3. smolt were slightly smaller than in 1992. The mean weight of ages-1. and -2. smolt was above average, whereas age-3. fish weighed more than in 1992. For the 1990-91 migrations, too few age-3. fish were sampled to evaluate growth differences.

The 1993 smolt migration timing peaked during 24-30 May for age-3. fish and about 31 May through 6 June for age-2. (Figure 13).

The apparent shift toward older age smolt has also been observed in the fall townet data. In 1989 and 1991, age-2. sockeye fry were absent in the fall catch, but in 1992 represented 11% (S. Honnold, Alaska Department of Fish and Game, Kodiak, personal communication). The cause may be due to consecutive years of overescapement (1988-90) and lake fertilization (1988-92).

Based on 1991-93 outmigrant estimates, the 1989 BR produced an estimated 12.9 million smolt from a 0.36 million escapement (Figure 12; Table 4). The 1988 and 1990 BR's have produced roughly 50% fewer smolt, based on available smolt data. The 1991 BR has shown a discouraging response to date with less than 0.1 million estimated age-1. smolt outmigrants. Overall at Frazer, age-1. smolt production has decreased precipitously (1989-91), whereas age-2. smolt numbers appear to be stable (1989-90), and age-3. abundance has increased dramatically (1987-89).

The 1994 preliminary Frazer forecast is for a 700,000 fish run (Appendix H).

LITERATURE CITED

ADF&G (Alaska Department of Fish and Game). 1993. 1993 Cook Inlet/Kodiak/Chignik Commercial Fishing Regulations, Alaska Department of Fish and Game, Divison of Commercial Fisheries Management and Development, Juneau.

Barrett, B.M. 1989. Frazer Lake sockeye salmon investigations, 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 89-03, Juneau.

Barrett, B. M., and B.E. Monkiewicz 1989. A survey of the Kodiak Management Area salmon fishing grounds for oil spill contaminants, 16 April to 17 September, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K89-25, Kodiak.

Barrett, B. M., P.A. Roche, and C.O. Swanton. 1993. Sockeye salmon *Oncorhynchus nerka* smolt investigations at Red, Akalura, and Upper Station Lakes conducted in responce to the 1989 M/V EXXON VALDEZ oil spill, 1990-1992. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K93-01, Kodiak.

Bilton, H.T., and G.L. Robbins. 1971. Effects of starvation, feeding, and light period on circulus formation on scales of young sockeye salmon (*Oncorhynchus nerka*). J. Fish. Res. Bd. Canada 28: 1749-1755.

Brennan, K., D. Prokopowich, and D. Gretsch. 1993. Kodiak Management Area commercial salmon annual management report, 1992. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 4K93-28, Kodiak.

Clutter, R.I., and L.E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Int. Pac. Salmon Fish. Comm., Bull. 9. 159pp.

Ginetz, R.M.J. 1977. A review of the Babine Lake development project 1961-1976. Environment Canada. Fish and Marine Serv. Tech. Rept. Serv. No. Pac-T-77-6, 192p.

INPFC (International North Pacific Fisheries Commission). 1963. Annual Report 1961. Vancouver, British Columbia.

Koenings, J.P., and G.B. Kyle. 1991. Collapsed populations and delayed recovery of zooplankton in response to heavy juvenile sockeye salmon (*Oncorhynchus nerka*) foraging. (Proceedings: International Symposium on Biological Interactions of Enhanced and Wild Salmonids held at Nanaimo, B.C., Canada). Spec. Publ. Can J. Fish. and Aquat. Sci. In Review.

Koo, T.S.Y. 1962. Age designation in salmon. Pages 37-48. In: Studies of Alaska red salmon. University of Washington Press, Seattle.

LITERATURE CITED (Cont.)

Kyle, G.B., Koenings, J.P., and Barrett, B.M. 1988. Density dependent trophic level responses to an introduced run of sockeye salmon (*Oncorhynchus nerka*) at Frazer Lake, Kodiak Island, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 45:856-867.

McConnell, R.J., and Snyder, G.R. 1972. Key to field identification of anadromous juvenile salmonids in the Pacific Northwest. National Oceanic and Atmospheric Administration Technical Report National Marine Fisheries Service Circular 366, Seattle.

Mesiar, D.C. 1986. Timing, distribution, and estimated abundance of seaward migrating pink salmon (*Oncorhynchus gorbuscha*) in the Nushagak River, Alaska. Master's Thesis, University of Alaska, Juneau.

Rawson, K. 1984. An estimate of the size of a migrating population of juvenile salmon using an index of trap efficiency obtained by dye marking. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development Report 28, Juneau.

Roche, P.A. 1992. The estimated incidence of Upper Station late run sockeye salmon in the Alitak Bay District, Inner Akalura Section fishery of 20 August 1992. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K92-34, Kodiak.

Trautman, M.B. 1973. A guide to the collection and identification of presmolt Pacific salmon in Alaska with an illustrated key. National Oceanic and Atmospheric Administration Technical Memorandum National Marine Fisheries Services ABFL-2, Seattle.

Table 1. Red Lake sockeye salmon smolt numbers by year and age, and by brood year, escapement, and age, 1986-1993.

Smolt Year		Ages 1.0	Ages 2.0	Ages 3.0	Population Estimate Pt.	95% CI Low	95% CI High
1990	#	240,500	493,026	6,427	739,953	402,905	1,077,004
	%	32.5	66.6	0.0	100.0		
1991	#	105,467	119,849	38,184	263,500	178,221	348,782
	%	40.0	45.5	14.5	100.0		
1992	#	29,482	1,365,082	25,792	1,420,356	1,117,748	1,722,965
	%	2.1	96.1	1.8	100.0		
1993	#	303,462	193,884	86,644	583,990	436,166	731,804
	%	52.0	33.2	14.8	100.0		

Brood Year	Escapement	Smolt Numbers (by age) 1.0	2.0	3.0	Total
1986	318,135	[a]	[a]	6,427	6,427[b]
1987	261,913	[a]	493,026	38,184	531,210[b]
1988	291,774	240,500	119,849	25,792	386,141
1989	768,101	105,467	1,365,082	86,642	1,557,191
1990	371,282	29,482	193,882	[c]	223,364
1991	374,859	303,462	[c]	[c]	303,462
1992	344,184				
1993	286,170				

[a] Smolt outmigration not monitored
[b] Incomplete brood year data.
[c] Smolt of this age class have not outmigrated.

Table 2. Akalura Lake sockeye salmon smolt numbers by year and age, and by brood year, escapement, and age, 1986-1993.

Smolt Year		Ages 1.0	2.0	3.0	4.0	Population Estimate Pt.	95 % CI Low	High
1990	#	66,460	408,330	0	0	474,790	318,734	630,846
	%	14.0	86.0	0.0	0.0	100.0		
1991	#	9,086	299,591	1,251	0	309,928	237,981	381,875
	%	2.9	96.7	0.04	0.0	100.0		
1992	#	1,921	182,963	8,315	0	193,199	153,765	232,638
	%	2.9	96.7	4.3	0.0	100.0		
1993	#	3,259	73,062	12,315	238	88,874	35,943	141,802
	%	3.7	82.3	13.9	0.1	100.0		

Brood Year	Escapement	Smolt Numbers (by age) 1.0	2.0	3.0	4.0	Total
1986	9,800	[a]	[a]	0	0	[a]
1987	6,116	[a]	408,330	1,251	0	409,581[b]
1988	38,618	66,460	299,591	8,315	238	374,604
1989	116,029	9,086	182,963	12,315	[c]	204,364
1990	47,181	1,921	73,062	[c]	[c]	74,983
1991	44,189	3,259	[c]	[c]	[c]	3,259
1992	63,269					
1993	30,692					

[a] Population estimates not currently available
[b] Incomplete brood year data.
[c] Smolt of this age class have not outmigrated.

Table 3. Upper Station sockeye salmon smolt numbers by year and age, and by brood year, escapement, and age, 1986-1993.

Smolt Year		Ages 0.0	1.0	2.0	3.0	Population Estimate Pt.	95% CI Low	High
1990	#	5,511,473	241,181	1,591,424	58,682	7,402,760	3,962,768	10,842,756
	%	74.4	3.3	21.5	0.8	100.0		
1991	#	1,959,424	224,621	245,673	15,388	2,445,106	1,258,660	3,527,829
	%	80.1	9.2	10.1	0.6	100.0		
1992	#	1,950,244	80,238	362,990	1,444	2,394,916	1,511,502	3,278,334
	%	81.4	3.3	15.2	0.1	100.0		
1993	#	2,528,937	568,342	354,833	9,946	3,462,058	2,720,652	4,203,464
	%	73.0	16.4	10.3	0.3	100.0		

Brood Year	Escapement Early	Late	Total	Smolt Numbers (by age) 0.0	1.0	2.0	3.0	Total
1986	100,163	366,222	466,385	[a]	[a]	[a]	58,682	56,682[b]
1987	75,921	156,274	232,195	[a]	[a]	1,591,424	15,389	1,606,813[b]
1988	58,913	247,647	306,560	[a]	241,181	245,673	1,444	488,298[b]
1989	64,582	221,706	286,288	5,511,473	244,621	362,990	9,946	6,129,030
1990	56,159	198,287	254,446	1,959,423	80,238	354,833	[c]	2,394,494
1991	50,026	242,860	292,886	1,950,244	568,342	[c]	[c]	2,518,586
1992	19,076	199,067	218,143	2,528,937	[c]	[c]	[c]	2,528,937
1993	34,852	187,529	222,381					

[a] Smolt outmigration not monitored.
[b] Incomplete brood year data.
[c] Smolt of this age class have not outmigrated.

Table 4. Frazer Lake sockeye salmon smolt numbers by year and age, and by brood year, escapement, and age, 1986-1993.

Smolt Year		Ages 1.0	2.0	3.0	4.0	Population Estimate Pt.	95% CI Low	High
1991	#	2,552,835	3,777,426	3,786	0	6,334,047	2,128,460	10,539,634
	%	40.3	59.6	0.1	0.0	100.0		
1992	#	108,489	5,739,150	557,584	0	6,405,223	2,649,678	10,160,766
	%	2.9	89.6	8.7	0.0	100.0		
1993	#	23,496	5,077,865	4,687,084	612	9,789,057	3,309,885	16,268,229
	%	0.2	51.9	47.9	0.0	100.0		

Brood Year	Escapement	Smolt Numbers (by age) 1.0	2.0	3.0	4.0	Total
1986	126,529	[a]	[a]	[a]	0	[b]
1987	40,544	[a]	[a]	3,786	0	3,786[b]
1988	246,704	[a]	3,777,426	557,584	612	4,335,622[b]
1989	360,373	2,552,835	5,739,150	4,687,083	[c]	12,979,068
1990	226,960	108,489	5,077,866	[c]	[c]	5,186,355
1991	190,358	23,496	[c]	[c]	[c]	23,496
1992	185,825					
1993	178,391					

[a] Population estimates not currently available
[b] Incomplete brood year data.
[c] Smolt of this age class have not outmigrated.

Table 5. Mean smolt length by system, age, and year, 1990-1993.

System	Smolt Year	Smolt Fork Length (mm)														
		Age-0.0			Age-1.0			Age-2.0			Age-3.0			Age-4.0		
		N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE
Red Lake																
	1990	0			342	106.5	0.2	1,052	111.8	0.3	20	117.9	1.9	0		
	1991	0			1,135	88.2	0.1	977	106.7	0.3	407	113.0	0.3	0		
	1992	0			85	99.5	0.9	1,667	110.2	0.2	63	119.7	1.4	0		
	1993	0			1,409	91.7	0.1	516	108.6	0.5	397	120.1	0.6	0		
Akalura																
	1990	0			577	73.9	0.3	748	85.9	0.2	0			0		
	1991	0			41	77.2	2.0	1,382	77.5	0.2	22	97.3	4.0	0		
	1992	1	59.0		25	75.7	1.0	2,014	78.8	0.1	61	86.4	0.6	0		
	1993	0			74	61.8	1.2	992	85.8	0.2	94	90.8	0.7	2	101.5	2.5
Upper Station																
	1990	939	54.5	0.2	325	81.4	0.4	1,539	99.7	0.2	74	109.7	0.8	0		
	1991	1,622	59.3	0.2	658	94.0	0.4	947	102.3	0.3	72	115.0	1.1	0		
	1992	1,813	57.5	0.1	477	93.7	0.4	1,841	103.3	0.2	8	112.6	2.3	0		
	1993	2,311	60.5	0.1	1,113	92.0	0.2	853	111.4	0.4	27	119.6	2.5	0		
Frazer																
	1990	0			574	84.2	0.2	553	104.3	0.2	44	113.0	1.6	0		
	1991	0			746	89.7	0.2	1,344	89.5	0.2	4	120.8	9.1	0		
	1992	0			49	86.4	1.1	2,951	83.9	0.1	191	91.1	0.5	0		
	1993	0			8	89.9	0.5	682	100.3	0.1	913	104.2	0.2	3	121.3	9.4

Table 6. Mean smolt weight by system, age, and year, 1990-1993.

System	Smolt Year	Smolt Weight (g)														
		Age-0.0			Age-1.0			Age-2.0			Age-3.0			Age-4.0		
		N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE
Red Lake																
	1990	0			341	10.0	>0.1	1,050	11.0	>0.1	20	13.0	0.1	0		
	1991	0			1,135	5.0	0.0	977	9.5	0.1	407	11.3	0.1	0		
	1992	0			85	8.8	0.3	1,666	11.8	0.1	63	15.2	0.6	0		
	1993	0			1,409	7.3	>0.1	517	11.0	0.1	395	14.5	0.2	0		
Akalura																
	1990	0			577	3.6	<0.1	749	5.3	<0.1	0			0		
	1991	0			41	4.3	0.5	1,382	4.0	0.0	22	8.9	1.2	0		
	1992	1	1.5		25	3.7	0.3	2,007	3.9	0.0	61	4.9	0.1	0		
	1993	0			74	2.2	0.1	992	5.7	0.0	94	6.8	0.2	2	10.1	0.5
Upper Station																
	1990	937	1.5	0.1	324	4.9	0.1	1,538	8.3	0.1	74	11.1	0.2	0		
	1991	1,622	2.0	0.0	660	7.1	0.1	946	9.3	0.1	71	12.8	0.4	0		
	1992	1,813	1.8	0.0	477	7.9	0.1	1,841	10.1	0.0	8	13.6	1.2	0		
	1993	2,311	2.1	0.1	1,113	6.3	0.1	852	11.7	0.1	27	14.9	0.9	0		
Frazer																
	1990	0			574	4.5	0.0	552	9.0	0.1	44	12.2	0.7	0		
	1991	0			745	5.4	0.0	1,343	5.6	0.0	4	15.7	3.9	0		
	1992	0			49	6.1	0.2	2,947	5.5	0.0	194	7.2	0.1	0		
	1993	0			8	6.1	0.2	684	8.3	0.0	899	9.2	0.0	2	17.7	5.1

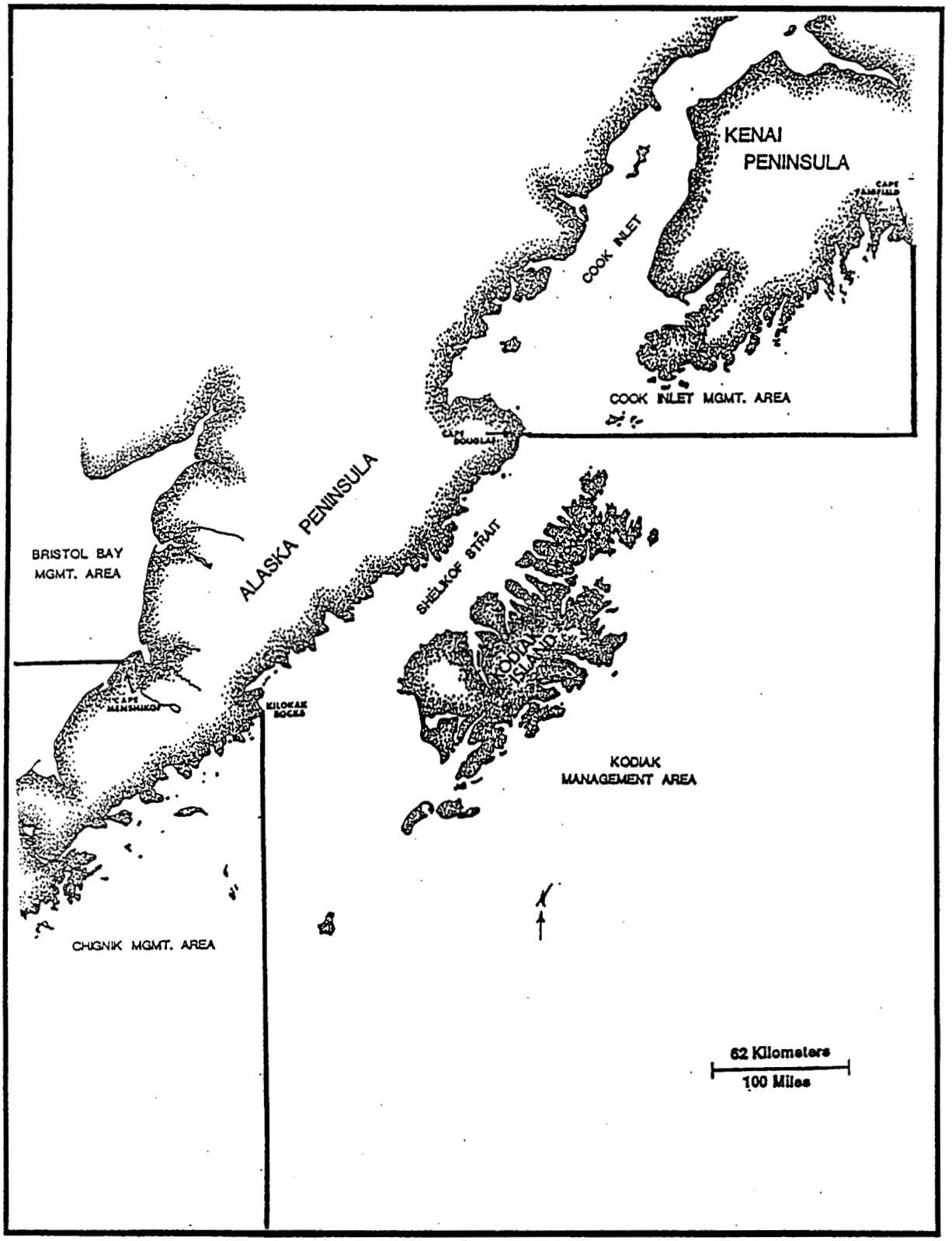

Figure 1. Map depicting Kodiak and adjacent salmon management areas.

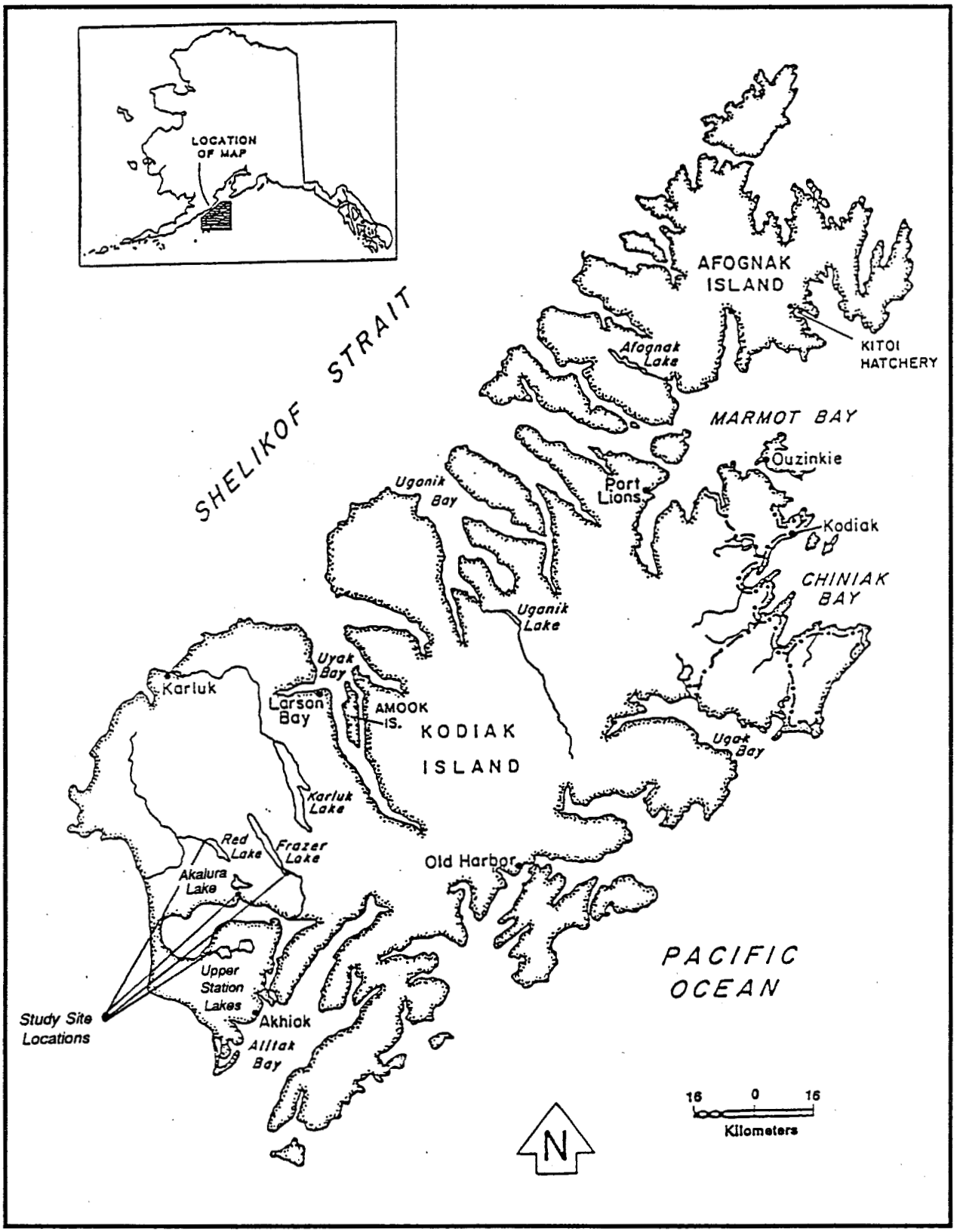

Figure 2. Map depicting locations of sockeye salmon smolt study sites at Red, Akalura, Upper Station, and Frazer lakes, Kodiak, Island, Alaska.

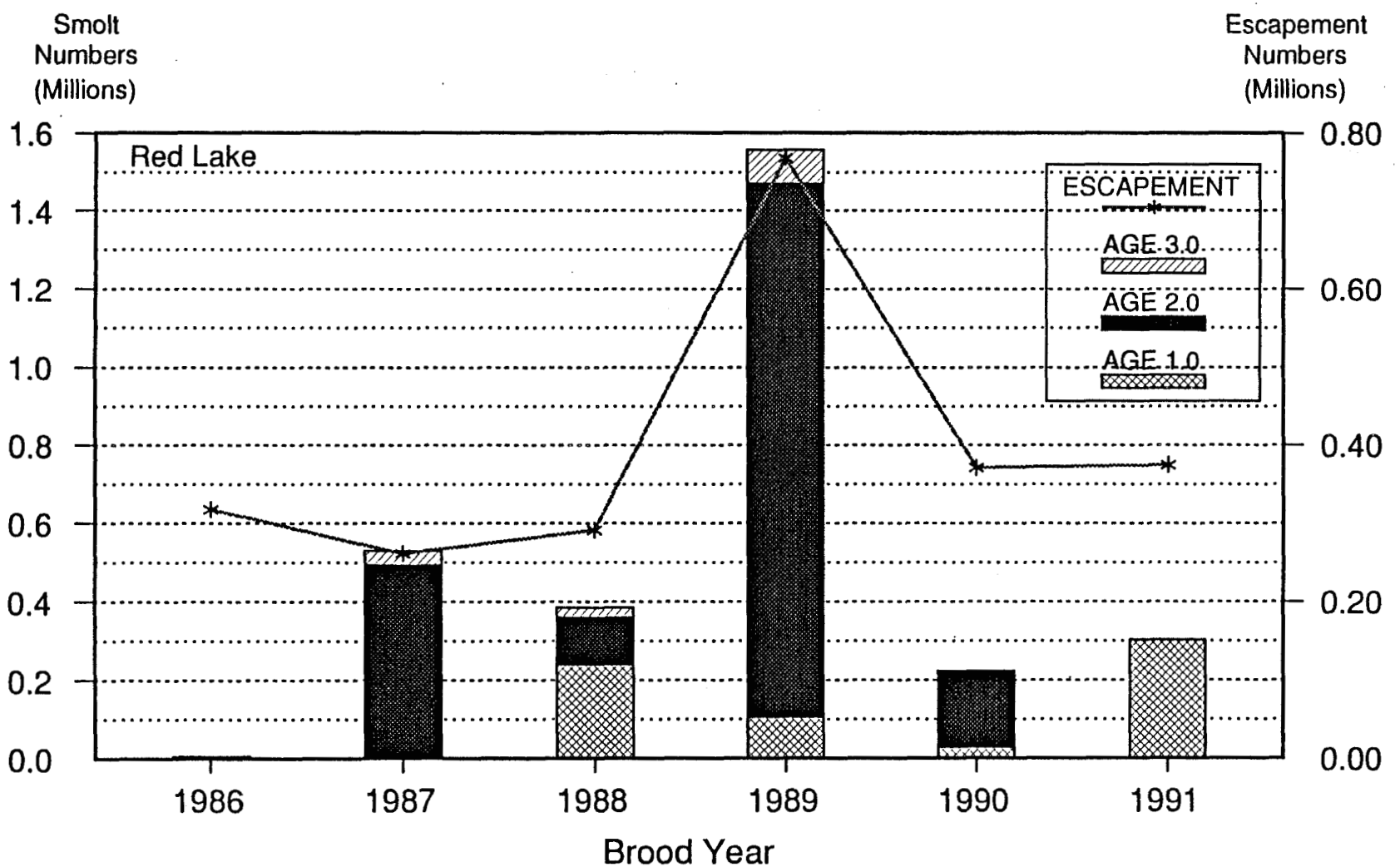

Figure 3. Sockeye salmon escapement and smolt production by age and brood year, Red lake, 1986-1991.

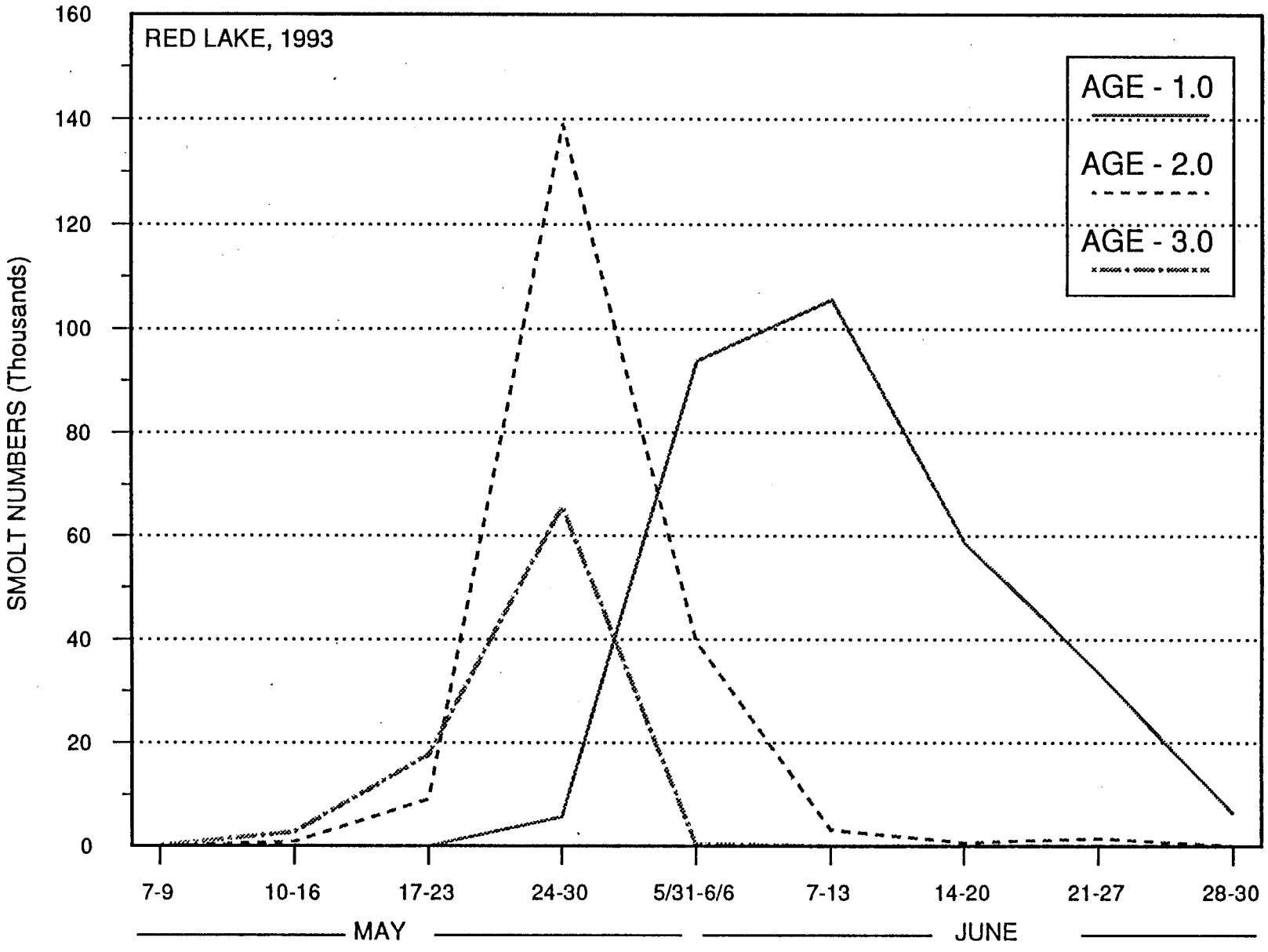

Figure 4. Sockeye salmon smolt outmigration timing by age, Red Lake, 1993.

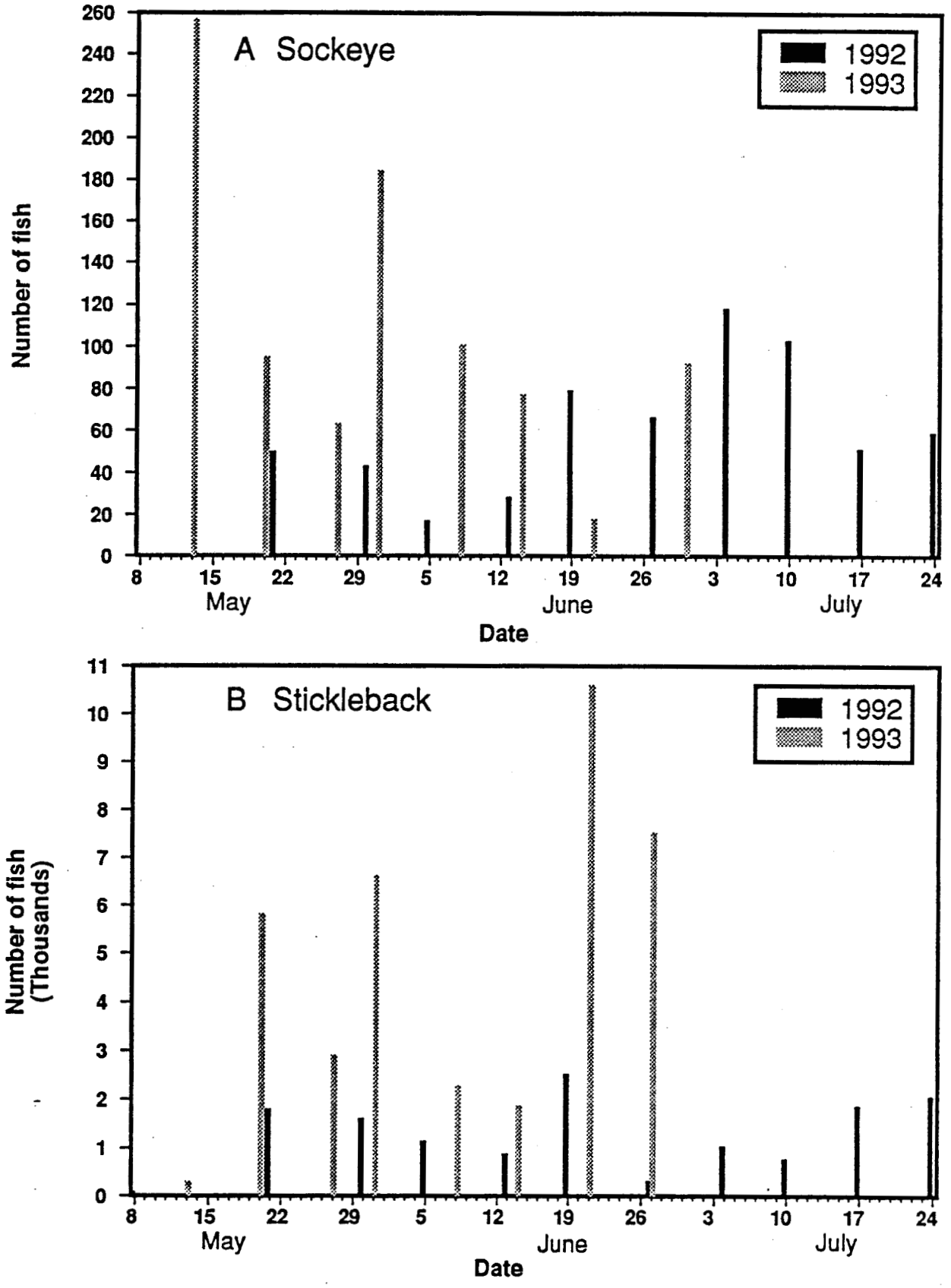

Figure 5. Sockeye fry (A) and stickleback (B) littoral zone seine catch by date, Red Lake, 1992-1993.

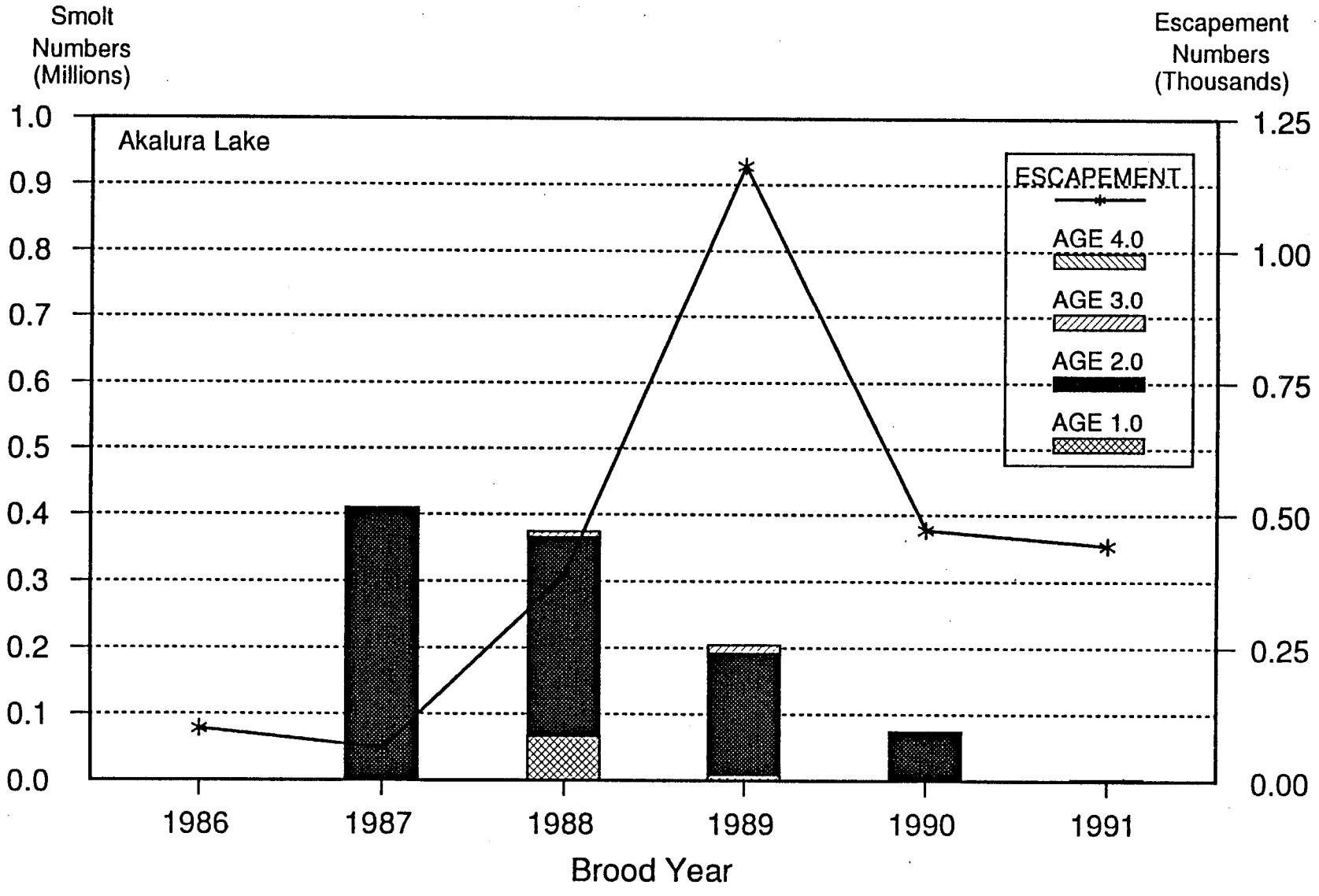

Figure 6. Sockeye salmon escapement and smolt production by age and brood year, Akalura Lake, 1986-1991.

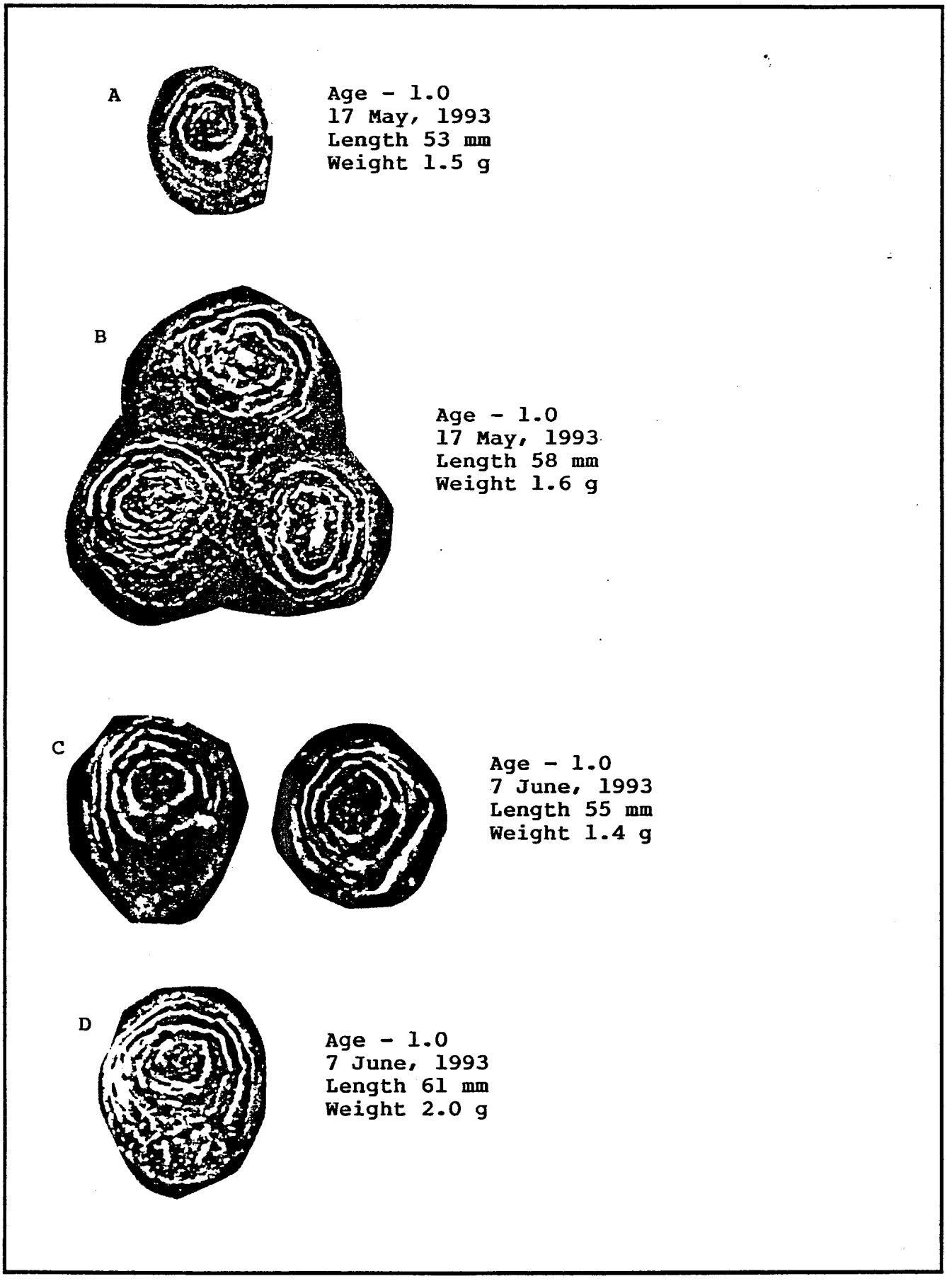

Figure 7. Examples of age-1.0 sockeye salmon smolt scales (54X), Akalura Lake, 1993.

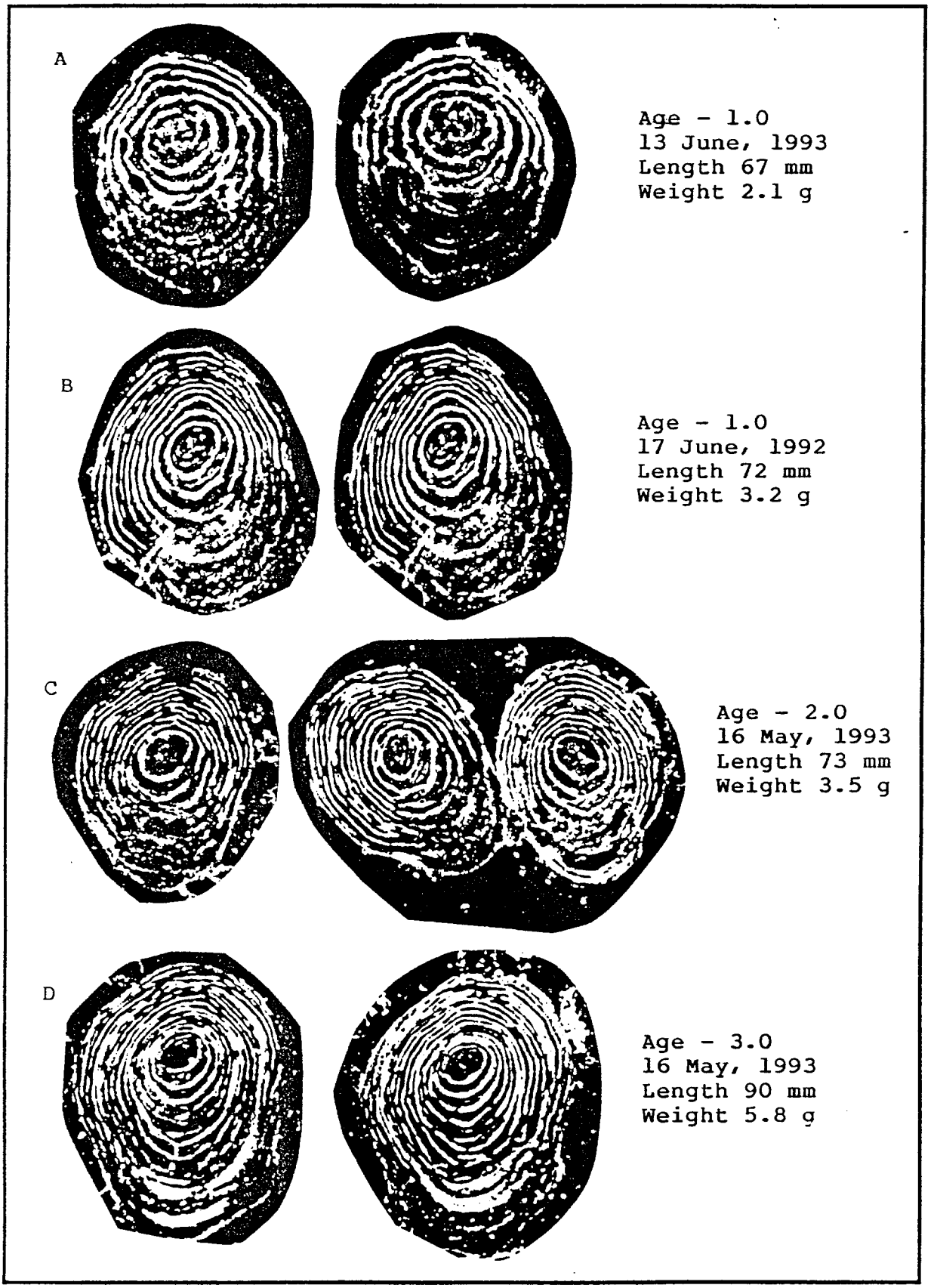

Figure 8. Examples of selected age specific sockeye salmon smolt scales (54X), Akalura Lake, 1992-1993.

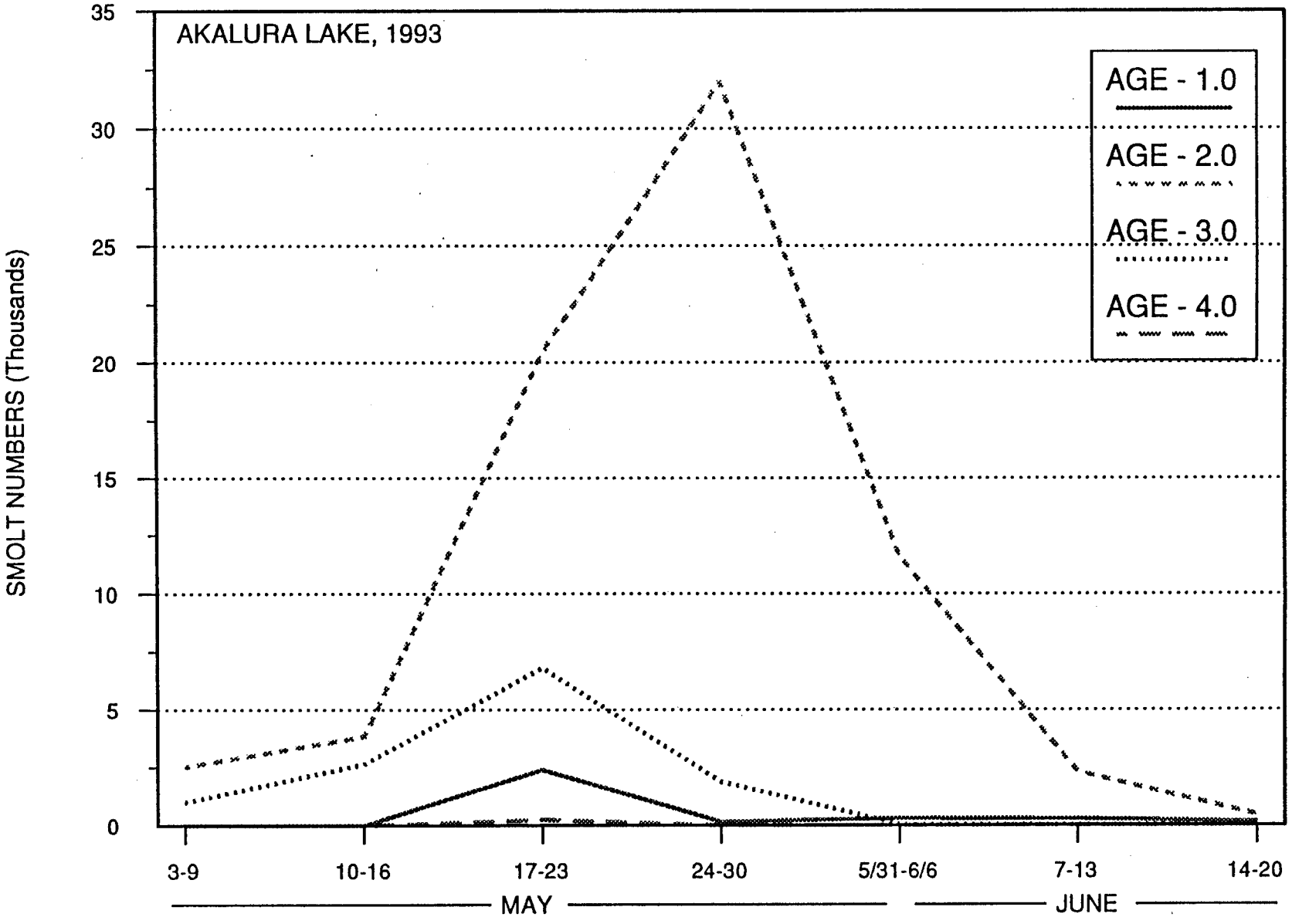

Figure 9. Sockeye salmon smolt outmigration timing by age, Akalura Lake, 1993.

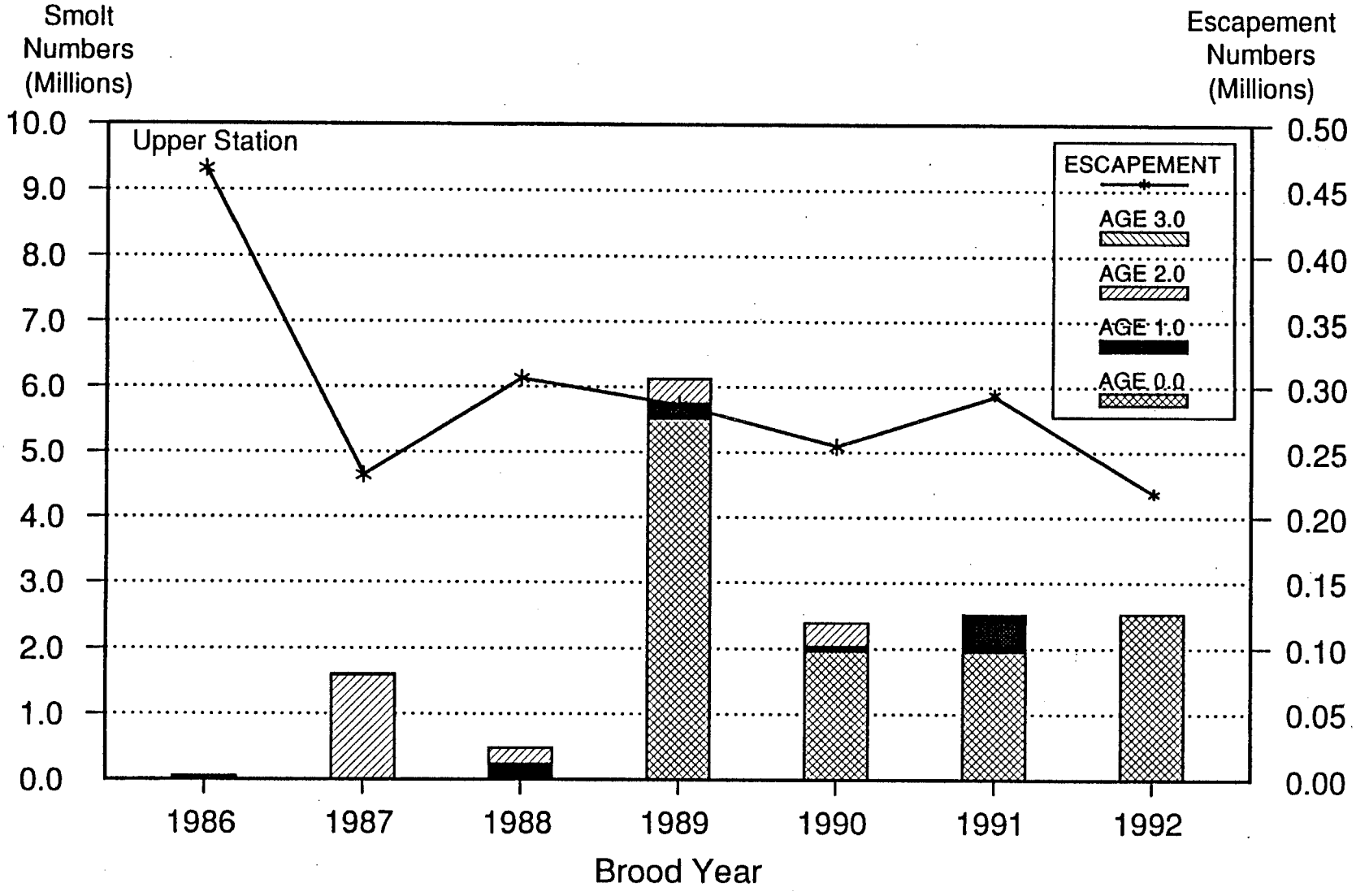

Figure 10. Sockeye salmon escapement and smolt production by age and brood year, Upper Station, 1986-1992.

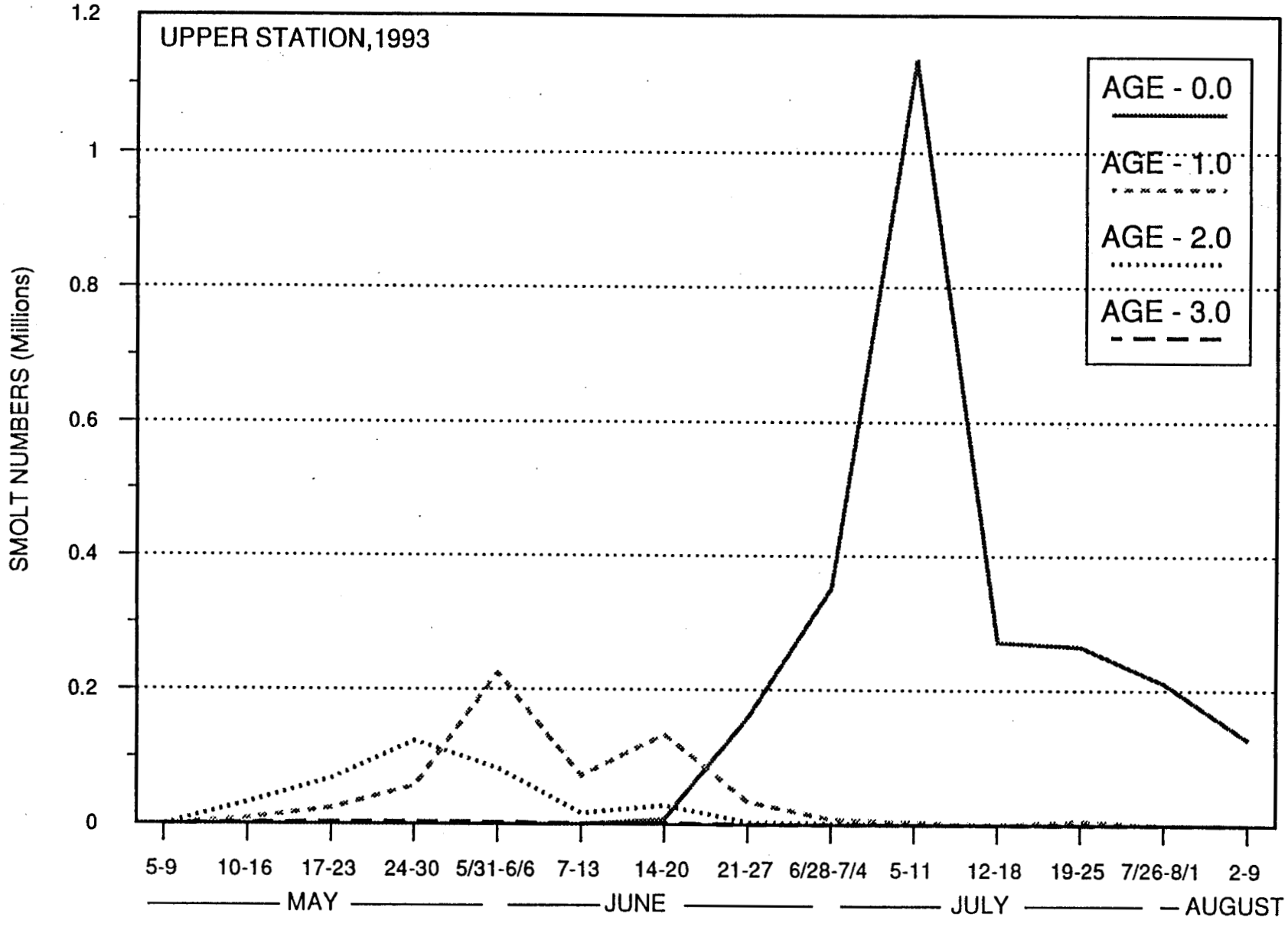

Figure 11. Sockeye salmon smolt outmigration timing by age, Upper Station, 1993.

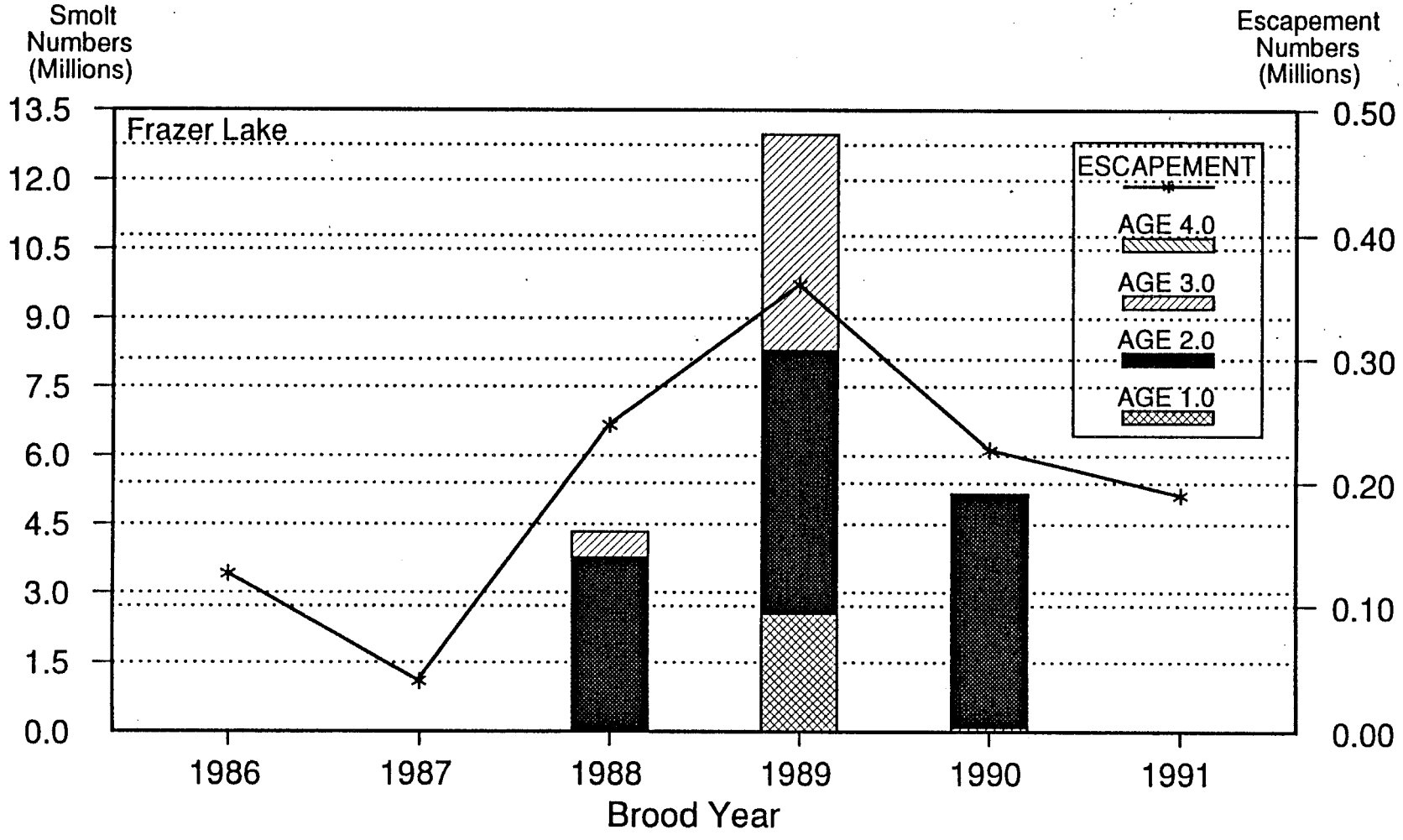

Figure 12. Sockeye salmon escapement and smolt production by age and brood year, Frazer Lake, 1986-1991.

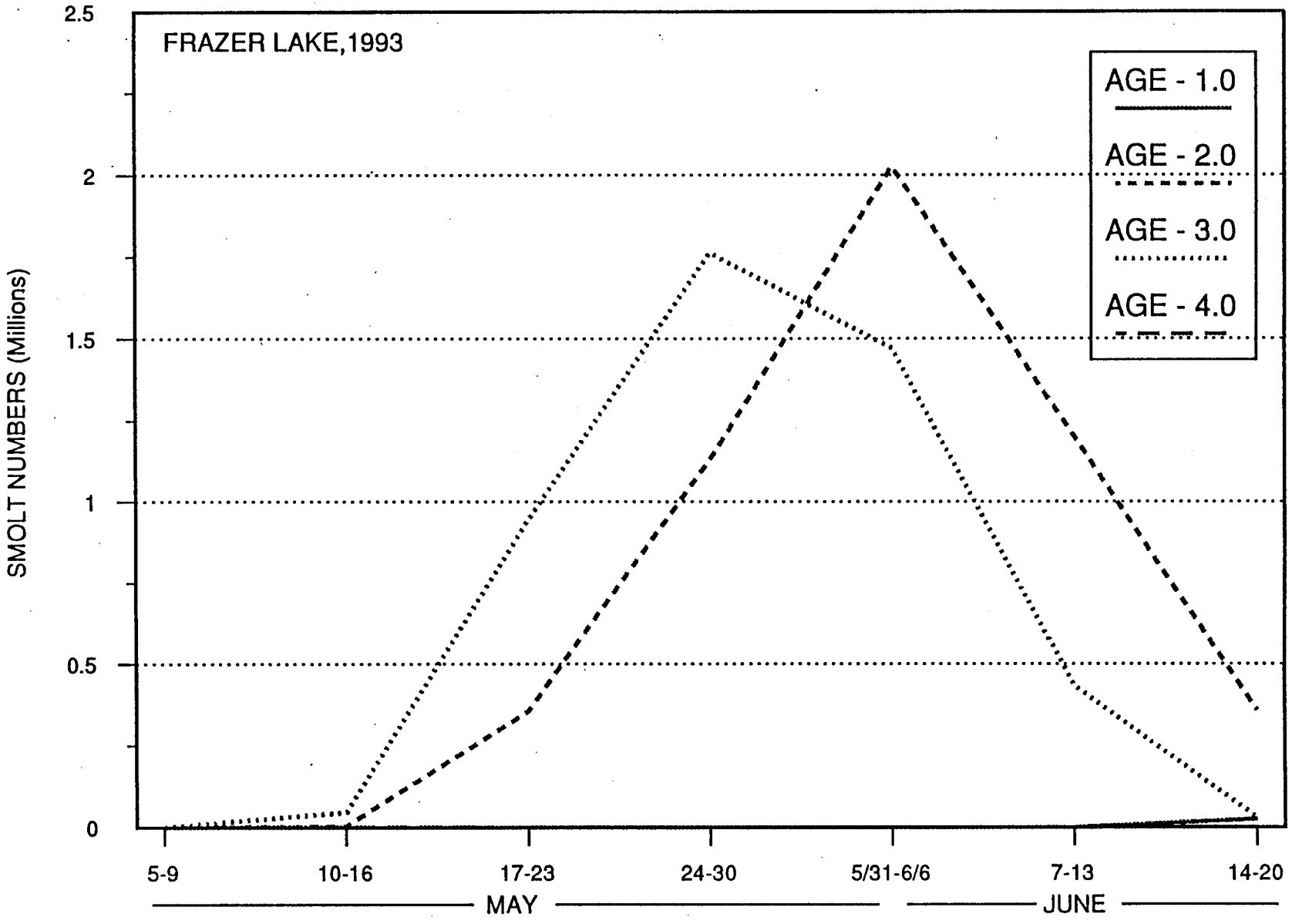

Figure 13. Sockeye salmon smolt outmigration timing by age, Frazer Lake, 1993.

APPENDIX

Appendix A.1. Red Lake daily sockeye salmon smolt trap catch and trap efficiency estimates, 1993.

	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
03-May	0	0	0	0			
04-May	0	0	0	0			
05-May	0	0	0	0			
06-May	0	0	0	0			
07-May	5	5	0	0			
08-May	5	10	0	0			
09-May	12	22	0	0			
10-May	19	41	0	0			
11-May	24	65	0	0			
12-May	108	173	0	0			
13-May	150	323	0	0			
14-May	252	575	0	0			
15-May	52	627	0	0			
16-May	148	775	452	233	85	96	21.2%
17-May	97	872	0	108	11		
18-May	63	935	0	63	0		
19-May	100	1,035	0	0			
20-May	453	1,488	0	0			
21-May	283	1,771	0	0			
22-May	2,434	4,205	0	0			
23-May	1,106	5,311	554	1,166	60	64	11.6%
24-May	337	5,648	0	341	4		
25-May	855	6,503	0	855	0		
26-May	1,100	7,603	559	1,127	27	41	7.3%
27-May	323	7,926	0	335	12		
28-May	1,729	9,655	0	1,731	2		
29-May	6,271	15,926	0	0			
30-May	5,531	21,457	0	0			
31-May	1,025	22,482	0	0			
01-Jun	1,317	23,799	0	0			
02-Jun	1,413	25,212	506	1,445	37	49	9.7%
03-Jun	3,452	28,664	0	3,459	7		
04-Jun	2,403	31,067	0	2,408	5		
05-Jun	1,884	32,951	0	0			
06-Jun	1,310	34,261	0	0			
07-Jun	1,233	35,494	0	0			
08-Jun	1,841	37,335	0	0			
09-Jun	1,678	39,013	484	1,722	45	61	12.6%
10-Jun	2,870	41,883	0	2,883	13		
11-Jun	1,784	43,667	0	1,787	3		
12-Jun	1,636	45,303	0	0			
13-Jun	2,284	47,587	0	0			
14-Jun	1,733	49,320	0	0			
15-Jun	1,191	50,511	0	0			
16-Jun	611	51,122	506	653	42	75	14.8%
17-Jun	1,098	52,220	0	1,129	31		
18-Jun	1,020	53,240	0	1,022	2		
19-Jun	1,495	54,735	0	0			
20-Jun	1,255	55,990	0	0			
21-Jun	1,125	57,115	0	0			
22-Jun	1,020	58,135	0	0			
23-Jun	522	58,657	551	580	58	82	14.9%
24-Jun	406	59,063	0	429	23		
25-Jun	925	59,988	0	926	1		
26-Jun	474	60,462	0	0			

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Appendix A.1. (page 2 of 2)

	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
27-Jun	653	61,115	0	0			
28-Jun	459	61,574	0	0			
29-Jun	383	61,957	0	0			
30-Jun	97	62,054	0	0			
Total	62,054		3,612	24,402	468	468	13.0%

a Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

b Number of fish caught does not include mark recoveries from trap efficiency tests.

c Represents the estimated sum of marked recoveries for the particular dye test period.

d Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.2. Akalura Lake daily sockeye salmon smolt trap catch and estimated trap efficiency, 1993.

	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
01-May	0	0	0	0			
02-May	0	0	0	0			
03-May	14	14	0	0			
04-May	9	23	0	0			
05-May	4	27	0	0			
06-May	4	31	0	0			
07-May	2	33	0	0			
08-May	3	36	0	0			
09-May	7	43	0	0			
10-May	3	46	0	0			
11-May	4	50	0	0			
12-May	9	59	0	0			
13-May	11	70	0	0			
14-May	14	84	0	0			
15-May	19	103	0	0			
16-May	20	123	41	21	1	1	2.4%
17-May	58	181	0	58	0		
18-May	104	285	0	104	0		
19-May	62	347	0	0			
20-May	87	434	0	0			
21-May	29	463	0	0			
22-May	153	616	174	161	8	10	5.7%
23-May	330	946	0	330	0		
24-May	554	1,500	0	556	2		
25-May	196	1,696	520	203	7	19	3.7%
26-May	77	1,773	0	86	9		
27-May	139	1,912	0	142	3		
28-May	656	2,568	0	0			
29-May	576	3,144	584	617	41	91	15.6%
30-May	559	3,703	0	601	42		
31-May	830	4,533	0	838	8		
01-Jun	367	4,900	0	0			
02-Jun	217	5,117	0	0			
03-Jun	141	5,258	0	0			
04-Jun	96	5,354	0	0			
05-Jun	91	5,445	340	110	19	52	15.3%
06-Jun	91	5,536	0	114	23		
07-Jun	94	5,630	0	104	10		
08-Jun	79	5,709	0	0			
09-Jun	52	5,761	0	0			
10-Jun	65	5,826	0	0			
11-Jun	32	5,858	0	0			
12-Jun	35	5,893	0	0			
13-Jun	31	5,924	0	0			
14-Jun	16	5,940	0	0			
15-Jun	16	5,956	0	0			
16-Jun	16	5,972	0	0			
17-Jun	18	5,990	0	0			

-Continued-

Appendix A.2. (page 2 of 2)

	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
18-Jun	10	6,000	0	0			
19-Jun	7	6,007	0	0			
20-Jun	5	6,012	0	0			
Total	6,012		1,659	4,045	173	173	10.4%

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Number of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the estimated sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.3. Upper Station daily sockeye salmon smolt trap catch and trap efficiency estimates, 1993.

	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
04-May	0	0	0	0			
05-May	0	0	0	0			
06-May	0	0	0	0			
07-May	0	0	0	0			
08-May	0	0	0	0			
09-May	0	0	0	0			
10-May	5	5	0	0			
11-May	35	40	0	0			
12-May	791	831	0	0			
13-May	904	1,735	0	0			
14-May	1,432	3,167	503	1,498	66	67	13.3%
15-May	1,185	4,352	0	1,186	1		
16-May	1,000	5,352	0	1,000	0		
17-May	509	5,861	0	0			
18-May	575	6,436	0	0			
19-May	1,013	7,449	0	0			
20-May	473	7,922	0	0			
21-May	687	8,609	458	702	15	22	4.8%
22-May	1,615	10,224	0	1,621	6		
23-May	4,398	14,622	0	4,399	1		
24-May	11,273	25,895	520	11,260	45	45	8.7%
25-May	1,146	27,041	0	1,146	0		
26-May	711	27,752	0	711	0		
27-May	575	28,327	0	0			
28-May	738	29,065	0	0			
29-May	235	29,300	0	0			
30-May	700	30,000	0	0			
31-May	2,365	32,365	509	2,369	4	10	2.0%
01-Jun	3,839	36,204	0	3,845	6		
02-Jun	2,745	38,949	0	2,745	0		
03-Jun	2,519	41,468	529	2,534	16	37	7.0%
04-Jun	2,355	43,823	0	2,371	16		
05-Jun	2,709	46,532	0	2,714	5		
06-Jun	4,598	51,130	0	0			
07-Jun	1,525	52,655	0	0			
08-Jun	725	53,380	0	0			
09-Jun	244	53,624	0	0			
10-Jun	694	54,318	0	0			
11-Jun	368	54,686	527	381	13	23	4.4%
12-Jun	440	55,126	0	448	8		
13-Jun	390	55,516	0	392	2		
14-Jun	722	56,238	0	0			
15-Jun	1,450	57,688	0	0			
16-Jun	1,839	59,527	0	0			
17-Jun	1,359	60,886	0	0			
18-Jun	2,333	63,219	530	2,373	40	73	13.8%
19-Jun	1,431	64,650	0	1,460	29		
20-Jun	1,917	66,567	0	1,921	4		
21-Jun	1,188	67,755	0				
22-Jun	5,627	73,382	0				
23-Jun	4,790	78,172	0				
24-Jun	4,563	82,735	0				
25-Jun	12,214	94,949	0				
26-Jun	4,227	99,176	529	4,327	102	117	22.1%
27-Jun	5,590	104,766	0	5,605	15		
28-Jun	3,491	108,257	0	3,491	0		
29-Jun	10,132	118,389	0				

-Continued-

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	Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
30-Jun	12,769	131,158	0				
01-Jul	4,145	135,303	0				
02-Jul	13,426	148,729	0				
03-Jul	10,028	158,757	509	10,059	72	80	15.7%
04-Jul	9,952	168,709	0	9,960	8		
05-Jul	15,712	184,421	0	15,712	0		
06-Jul	18,412	202,833	0				
07-Jul	7,977	210,810	0				
08-Jul	28,918	239,728	0				
09-Jul	76,630	316,358	396	782	2	40	10.1%
10-Jul	20,744	337,102	0	20,782	38		
11-Jul	20,285	357,387	0	20,285	0		
12-Jul	3,181	360,568	0	3,181	0		
13-Jul	1,574	362,142	0				
14-Jul	3,520	365,662	0				
15-Jul	4,333	369,995	0				
16-Jul	19,948	389,943	0				
17-Jul	15,573	405,516	0				
18-Jul	2,818	408,334	0				
19-Jul	3,676	412,010	0				
20-Jul	6,220	418,230	0				
21-Jul	8,099	426,329	447	303	2	91	20.4%
22-Jul	11,390	437,719	0	11,474	84		
23-Jul	10,844	448,563	0	10,848	4		
24-Jul	6,890	455,453	0	6,891	1		
25-Jul	7,217	462,670	0				
26-Jul	4,795	467,465	0				
27-Jul	10,884	478,349	0				
28-Jul	3,175	481,524	0				
29-Jul	6,305	487,829	562	6,407	106	122	21.7%
30-Jul	8,244	496,073	0	8,260	16		
31-Jul	4,775	500,848	0	4,775	0		
01-Aug	6,883	507,731	0				
02-Aug	7,184	514,915	0				
03-Aug	2,027	516,942	0				
04-Aug	3,237	520,179	0				
05-Aug	3,089	523,268	542	3,137	134	138	25.5%
06-Aug	2,604	525,872	0	2,608	4		
07-Aug	2,256	528,128	0	2,256	0		
08-Aug	4,948	533,076	0				
09-Aug	5,999	539,075	0				
Total	539,075		6,561	198,219	865	865	13.2%

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Number of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the estimated sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.4. Frazer Lake daily sockeye salmon smolt concrete trap catch and trap efficiency estimates, 1991.

	Concrete Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
05-May	0	0	0	0			
06-May	0	0	0	0			
07-May	0	0	0	0			
08-May	0	0	0	0			
09-May	0	0	0	0			
10-May	0	0	0	0			
11-May	0	0	0	0			
12-May	0	0	0	0			
13-May	0	0	0	0			
14-May	1	1	0	0			
15-May	10	11	0	0			
16-May	3	14	0	0			
17-May	2	16	0	0			
18-May	97	113	0	0			
19-May	212	325	0	0			
20-May	58	383	0	0			
21-May	6	389	0	0			
22-May	340	729	0	0			
23-May	45,521	46,250	0	0			
24-May	1,256	47,506	997	1,265	9	15	1.5
25-May	825	48,331	0	829	4		
26-May	0	48,331	0	1	1		
27-May	0	48,331	0	0			
28-May	181	48,512	0	0			
29-May	482	48,994	0	0	1		
30-May	222	49,216	991	225	3	5	0.5
31-May	17	49,233	0	18	1		
01-Jun	270	49,503	0	271	1		
02-Jun	12,001	61,504	0	0			
03-Jun	299	61,803	0	0			
04-Jun	2,702	64,505	0	0			
05-Jun	55,140	119,645	0	0			
06-Jun	12,257	131,902	941	6,752	3	8	0.9
07-Jun	547	132,449	0	548	1		
08-Jun	813	133,262	0	815	2		
09-Jun	4,067	137,329	0	0	1		
10-Jun	2,118	139,447	0	0	1		
11-Jun	188	139,635	0	0			
12-Jun	1,471	141,106	0	0			
13-Jun	2,454	143,560	980	2,457	3	10	1.0
14-Jun	1,826	145,386	0	1,829	3		
15-Jun	201	145,587	0	203	2		
16-Jun	109	145,696	0	0	2		
17-Jun	0	145,696	0	0			
18-Jun	1	145,697	0	0			
19-Jun	1	145,698	0	0			
20-Jun	5	145,703	0	0			
21-Jun	123	145,826	0	0			
22-Jun	58	145,884	0	0			
23-Jun	43	145,927	0	0			
24-Jun	5	145,932	0	0			
25-Jun	10	145,942	0	0			
26-Jun	177	146,119	0	0			
27-Jun	133	146,252	1,037	134	1	3	0.3
28-Jun	110	146,362	0	111	1		
29-Jun	43	146,405	0	44	1		
30-Jun	60	146,465	0	0			

-Continued-

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	Concrete Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
01-Jul	20	146,485	0	0			
02-Jul	23	146,508	0	0			
03-Jul	5	146,513	0	0			
04-Jul	24	146,537	0	0			
05-Jul	1	146,538	0	0			
06-Jul	2	146,540	0	0			
07-Jul	0	146,540	0	0			
08-Jul	0	146,540	0	0			
09-Jul	1	146,541	0	0			
10-Jul	0	146,541	0	0			
11-Jul	0	146,541	0	0			

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Numbers of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.5. Frazer Lake daily sockeye salmon smolt incline trap catch and trap efficiency estimates, 1991.

	Incline Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
5-May	0	0	0	0			
6-May	0	0	0	0			
7-May	0	0	0	0			
8-May	0	0	0	0			
9-May	0	0	0	0			
10-May	0	0	0	0			
11-May	0	0	0	0			
12-May	0	0	0	0			
13-May	0	0	0	0			
14-May	0	0	0	0			
15-May	8	8	0	0			
16-May	7	15	0	0			
17-May	8	23	0	0			
18-May	45	68	0	0			
19-May	136	204	0	0			
20-May	12	216	0	0			
21-May	0	216	0	0			
22-May	223	439	0	0			
23-May	5,608	6,047	0	0			
24-May	0	6,047	997	2	2	4	0.4
25-May	2	6,049	0	4	2		
26-May	1	6,050	0	1	0		
27-May	2	6,052	0	0			
28-May	289	6,341	0	0			
29-May	1,467	7,808	0	0			
30-May	1,297	9,105	991	1,311	14	18	1.8
31-May	215	9,320	0	217	2		
01-Jun	510	9,830	0	512	2		
02-Jun	1,369	11,199	0	0			
03-Jun	3	11,202	0	0			
04-Jun	925	12,127	0	0			
05-Jun	2,684	14,811	0	0			
06-Jun	12,482	27,293	941	6,753	3	6	0.6
07-Jun	7	27,300	0	10	3		
08-Jun	730	28,030	0	730	0		
09-Jun	2,201	30,231	0	0			
10-Jun	1,017	31,248	0	0			
11-Jun	371	31,619	0	0			
12-Jun	872	32,491	0	0			
13-Jun	1,909	34,400	980	1,918	9	12	1.2
14-Jun	1,246	35,646	0	1,249	3		
15-Jun	769	36,415	0	769	0		
16-Jun	146	36,561	0	0			
17-Jun	9	36,570	0	0			
18-Jun	15	36,585	0	0			
19-Jun	4	36,589	0	0			
20-Jun	75	36,664	0	0			
21-Jun	3,479	40,143	0	0			
22-Jun	292	40,435	0	0			
23-Jun	50	40,485	0	0			
24-Jun	116	40,601	0	0			
25-Jun	339	40,940	0	0			
26-Jun	1,587	42,527	0	0			
27-Jun	1,571	44,098	1,037	1,603	32	43	4.1
28-Jun	765	44,863	0	776	11		
29-Jun	182	45,045	0	182	0		
30-Jun	666	45,711	0	0			

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	Incline Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
01-Jul	341	46,052	0	0			
02-Jul	63	46,115	0	0			
03-Jul	195	46,310	0	0			
04-Jul	139	46,449	0	0			
05-Jul	82	46,531	0	0			
06-Jul	41	46,572	0	0			
07-Jul	17	46,589	0	0			
08-Jul	23	46,612	0	0			
09-Jul	21	46,633	0	0			
10-Jul	7	46,640	0	0			
11-Jul	1	46,641	0	0			

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Numbers of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.6. Frazer Lake daily sockeye salmon smolt concrete trap catch and trap efficiency estimates, 1992.

	Concrete Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
05-May	0	0	0	0			
06-May	0	0	0	0			
07-May	0	0	0	0			
08-May	0	0	0	0			
09-May	21	21	0	0			
10-May	39	60	0	0			
11-May	12	72	0	0			
12-May	4	76	0	0			
13-May	103	179	0	0			
14-May	196	375	0	0			
15-May	1,234	1,609	278	1,234	0	2	0.7%
16-May	2,484	4,093	0	2,486	2		
17-May	1,155	5,248	0	1,155	0		
18-May	263	5,511	978	269	6	19	1.9%
19-May	243	5,754	0	245	2		
20-May	7,434	13,188	0	5,846	11[e]		
21-May	27,534	40,722	0	0			
22-May	2,683	43,405	0	0			
23-May	22,075	65,480	970	22,124	49	74	7.6%
24-May	11,254	76,734	0	11,276	22		
25-May	16,724	93,458	0	16,727	3		
26-May	833	94,291	0	0			
27-May	78	94,369	0	0			
28-May	179	94,548	0	0			
29-May	2,400	96,948	0	0			
30-May	419	97,367	1,058	137		3	0.3%
31-May	2,335	99,702	0	2,338	3		
01-Jun	6,705	106,407	0	6,705	0		
02-Jun	1,694	108,101	0	0			
03-Jun	591	108,692	0	0			
04-Jun	676	109,368	0	0			
05-Jun	2	109,370	0	0			
06-Jun	171	109,541	0	0			
07-Jun	1,865	111,406	712	1,851	0	1	0.1%
08-Jun	1439	112,845	0	1,440	1		
09-Jun	508	113,353	0	508	0		
10-Jun	2,112	115,465	0	0			
11-Jun	19	115,484	0	0			
12-Jun	10	115,494	0	0			
13-Jun	10	115,504	0	0			
14-Jun	588	116,092	0	0			
15-Jun	1,712	117,804	986	1,712	0	3	0.3%
16-Jun	686	118,490	0	688	2		
17-Jun	26	118,516	0	27	1		
18-Jun	147	118,663	0	0			
19-Jun	42	118,705	0	0			
20-Jun	0	118,705	0	0			
21-Jun	351	119,056	253	351	0	3	0.3%
22-Jun	190	119,246	710	191	1		
23-Jun	265	119,511	0	267	2		
24-Jun	232	119,743	0	232	0		
25-Jun	241	119,984	0	0			
26-Jun	3	119,987	0	0			
27-Jun	0	119,987	0	0			
28-Jun	0	119,987	0	0			
29-Jun	3	119,990	0	0			
30-Jun	223	120,213	356	223	0	2	0.3%

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	Concrete Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
01-Jul	232	120,445	405	233	1		
02-Jul	93	120,538	0	94	1		
03-Jul	116	120,654	0	116	0		
04-Jul	0	120,654	0	0			
05-Jul	0	120,654	0	0			
06-Jul	0	120,654	0	0			
07-Jul	5	120,659	0	0			
08-Jul	0	120,659	0	0			
09-Jul	0	120,659	0	0			
10-Jul	0	120,659	0	0			
11-Jul	0	120,659	0	0			
12-Jul	0	120,659	0	0			

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.
[b] Number of fish caught does not include mark recoveries from trap efficiency tests.
[c] Represents the estimated sum of marked recoveries for the particular dye test period.
[d] Determined from the cumulative number of marked and recovered fish by test period.
[e] Adjusted to include examination of all fish.

Appendix A.7. Frazer Lake daily sockeye salmon smolt incline trap catch and trap efficiency estimates, 1992.

	Incline Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
05-May	0	0	0				
06-May	0	0	0				
07-May	0	0	0				
08-May	0	0	0				
09-May	11	11	0				
10-May	37	48	0				
11-May	10	58	0				
12-May	6	64	0				
13-May	25	89	0				
14-May	96	185	0				
15-May	715	900	278	715	0	1	0.4%
16-May	1,214	2,114	0	1,215	1		
17-May	151	2,265	0	151	0		
18-May	22	2,287	978	25	3	4	0.4%
19-May	18	2,305	0	18	0		
20-May	708	3,013	0	709	1		
21-May	2,223	5,236	0	0			
22-May	505	5,741	0	0			
23-May	1,880	7,621	970	1,889	9	12	1.2%
24-May	1,524	9,145	0	1,527	3		
25-May	2,466	11,611	0	2,466	0		
26-May	600	12,211	0	0			
27-May	49	12,260	0	0			
28-May	763	13,023	0	0			
29-May	8,272	21,295	0	0			
30-May	1,482	22,777	1,058	252	9	51	4.8%
31-May	22,138	44,915	0	22,178	40		
01-Jun	18,793	63,708	0	18,795	2		
02-Jun	123	63,831	0	0			
03-Jun	543	64,374	0	0			
04-Jun	1,438	65,812	0	0			
05-Jun	85	65,897	0	0			
06-Jun	4,042	69,939	0	0			
07-Jun	24,392	94,331	712	17,816	2	14	2.0%
08-Jun	4,153	98,484	0	4,162	9		
09-Jun	1,516	100,000	0	1,519	3		
10-Jun	477	100,477	0	0			
11-Jun	41	100,518	0	0			
12-Jun	52	100,570	0	0			
13-Jun	238	100,808	0	0			
14-Jun	2,106	102,914	0	0			
15-Jun	2,355	105,269	986	2,366	11	14	1.4%
16-Jun	128	105,397	0	131	3		
17-Jun	62	105,459	0	62	0		
18-Jun	179	105,638	0	0			
19-Jun	69	105,707	0	0			
20-Jun	93	105,800	0	0			
21-Jun	472	106,272	253	473	1	7	0.7%
22-Jun	223	106,495	710	228	5		
23-Jun	315	106,810	0	315	0		
24-Jun	286	107,096	0	287	1		
25-Jun	5	107,101	0	0			
26-Jun	55	107,156	0	0			
27-Jun	38	107,194	0	0			
28-Jun	7	107,201	0	0			
29-Jun	402	107,603	0	0			
30-Jun	311	107,914	356	312	1	4	0.5%

-Continued-

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	Incline Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
01-Jul	124	108,038	405	127	3		
02-Jul	58	108,096	0	58	0		
03-Jul	124	108,220	0	124	0		
04-Jul	159	108,379	0	0			
05-Jul	70	108,449	0	0			
06-Jul	17	108,466	0	0			
07-Jul	2	108,468	0	0			
08-Jul	0	108,468	0	0			
09-Jul	11	108,479	0	0			
10-Jul	0	108,479	0	0			
11-Jul	4	108,483	0	0			
12-Jul	0	108,483	0	0			

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Number of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the estimated sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

Appendix A.8. Frazer Lake daily sockeye salmon smolt concrete trap catch and trap efficiency estimates, 1993.

	Concrete Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
05-May	0	0	0	0			
06-May	1	1	0	0			
07-May	2	3	0	0			
08-May	12	15	0	0			
09-May	36	51	0	0			
10-May	3	54	0	0			
11-May	39	93	0	0			
12-May	100	193	0	0			
13-May	255	448	0	0			
14-May	368	816	0	0			
15-May	1,227	2,043	580	1,234	7	16	2.8%
16-May	197	2,240	0	203	6		
17-May	6,247	8,487	0	6,250	3		
18-May	12,713	21,200	0	0			
19-May	22,229	43,429	0	0			
20-May	23,662	67,091	0	0			
21-May	25,297	92,388	0	0			
22-May	15,282	107,670	973	14,941	2	10	1.0%
23-May	13,080	120,750	0	13,087	7		
24-May	2,616	123,366	0	2,617	1		
25-May	1,576	124,942	0	0			
26-May	3,627	128,569	0	0			
27-May	1,094	129,663	0	0			
28-May	34,575	164,238	0	0			
29-May	53,101	217,339	1,034	52,839	1	101	9.8%
30-May	88,029	305,368	0	88,045	16		
31-May	93,320	398,688	0	93,344	24		
01-Jun	29,424	428,112	0	29,466[e]	42		
02-Jun	29,206	457,318	0	29,224[e]	18		
03-Jun	6,087	463,405	0	0			
04-Jun	3,949	467,354	0	0			
05-Jun	15,136	482,490	1,069	14,794	6	17	1.6%
06-Jun	6,495	488,985	0	6,502	7		
07-Jun	20,883	509,868	0	20,886	3		
08-Jun	5,239	515,107	0	5,240[e]	1		
09-Jun	7,751	522,858	0	0			
10-Jun	512	523,370	0	0			
11-Jun	11,881	535,251	0	0			
12-Jun	5,531	540,782	1,031	5,517	0	3	0.3%
13-Jun	3,488	544,270	0	3,491	3		
14-Jun	1,057	545,327	0	1,057	0		
15-Jun		545,327	0	0			
16-Jun		545,327	0	0			
17-Jun		545,327	0	0			
18-Jun		545,327	0	0			
19-Jun		545,327	0	0			
20-Jun		545,327	0	0			
Total	545,327		4,687	388,737	147	147	3.1%

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Number of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the estimated sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

[e] Checked trap due to unusual holding pattern in front of trap.

Appendix A.9. Frazer Lake daily sockeye salmon smolt incline trap catch and trap efficiency estimates, 1993.

	Incline Trap Catch		Trap Efficiency Test				
Date[a]	Daily[b]	Cum.	Marked (Dyed)	Examined For Marks	Marked Recoveries	Est. Total[c] Recoveries for Dye Test Period	Recovery Rate %[d]
05-May	0	0	0	0			
06-May	0	0	0	0			
07-May	2	2	0	0			
08-May	1	3	0	0			
09-May	0	3	0	0			
10-May	0	3	0	0			
11-May	0	3	0	0			
12-May	2	5	0	0			
13-May	10	15	0	0			
14-May	40	55	0	0			
15-May	121	176	580	124	3	3	0.5%
16-May	22	198	0	22	0		
17-May	304	502	0	304	0		
18-May	460	962	0	0			
19-May	1,480	2,442	0	0			
20-May	776	3,218	0	0			
21-May	2,179	5,397	0	0			
22-May	419	5,816	973	425	6	7	0.7%
23-May	1,083	6,899	0	1,084	1		
24-May	433	7,332	0	433	0		
25-May	146	7,478	0	0			
26-May	995	8,473	0	0			
27-May	705	9,178	0	0			
28-May	4,412	13,590	0	0			
29-May	9,755	23,345	1,034	9,495	3	8	0.8%
30-May	3,220	26,565	0	3,224	4		
31-May	5,606	32,171	0	5,607	1		
01-Jun	293	32,464	0	293[e]	0		
02-Jun	7,075	39,539	0	7,075[e]	0		
03-Jun	1,112	40,651	0	0			
04-Jun	245	40,896	0	0			
05-Jun	7,251	48,147	1,069	7,256	5	8	0.7%
06-Jun	2,027	50,174	0	2,030	3		
07-Jun	4,874	55,048	0	4,874	0		
08-Jun	1,667	56,715	0	1,667[e]	0		
09-Jun	972	57,687	0	0			
10-Jun	412	58,099	0	0			
11-Jun	103	58,202	0	0			
12-Jun	198	58,400	1,031	200	2	3	0.3%
13-Jun	410	58,810	0	411	1		
14-Jun	308	59,118	0	308	0		
15-Jun	131	59,249	0	0			
16-Jun	99	59,348	0	0			
17-Jun	150	59,498	0	0			
18-Jun	145	59,643	0	0			
19-Jun	49	59,692	0	0			
20-Jun	16	59,708	0	0			
Total	59,708		4,687	44,832	29	29	0.6%

[a] Each date listed covers a 24-hour period extending from noon to noon and identifies the date of the first noon of the 24-hour period.

[b] Number of fish caught does not include mark recoveries from trap efficiency tests.

[c] Represents the estimated sum of marked recoveries for the particular dye test period.

[d] Determined from the cumulative number of marked and recovered fish by test period.

[e] Checked trap due to unusual holding pattern in front of trap.

Appendix B.1. Red Lake daily sockeye salmon smolt population estimates, 1993.

Date	Population Estimate	95% CI	
		Lower	Upper
04-May	0	0	0
05-May	0	0	0
06-May	0	0	0
07-May	24	5	43
08-May	24	5	43
09-May	57	27	87
10-May	90	51	129
11-May	114	69	159
12-May	513	389	637
13-May	712	551	873
14-May	1,196	949	1,444
15-May	247	174	320
16-May	703	544	861
17-May	460	346	575
18-May	299	215	383
19-May	500	374	626
20-May	2,394	1,903	2,885
21-May	1,585	1,235	1,936
22-May	14,508	11,534	17,481
23-May	7,046	5,654	8,437
24-May	4,699	3,265	6,132
25-May	11,921	8,404	15,437
26-May	15,337	10,836	19,837
27-May	4,503	3,126	5,881
28-May	24,106	17,078	31,134
29-May	81,941	59,013	104,870
30-May	68,001	49,544	86,459
31-May	11,899	8,703	15,095
01-Jun	14,481	10,714	18,247
02-Jun	14,860	10,911	18,810
03-Jun	36,304	26,752	45,857
04-Jun	25,272	18,602	31,942
05-Jun	18,673	13,879	23,467
06-Jun	12,277	9,196	15,358
07-Jun	10,959	8,279	13,638
08-Jun	15,559	11,882	19,236
09-Jun	13,505	10,325	16,685
10-Jun	23,098	17,699	28,497
11-Jun	14,358	10,981	17,735
12-Jun	13,295	10,211	16,379
13-Jun	17,946	13,879	22,013
14-Jun	13,180	10,232	16,128
15-Jun	8,776	6,829	10,724
16-Jun	4,169	3,257	5,081
17-Jun	7,492	5,893	9,091
18-Jun	6,960	5,470	8,449
19-Jun	10,192	8,036	12,349
20-Jun	8,549	6,733	10,365
21-Jun	7,657	6,026	9,289

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Appendix B.1. (page 2 of 2)

Date	Population Estimate	95% CI	
		Lower	Upper
22-Jun	6,937	5,455	8,419
23-Jun	3,544	2,791	4,297
24-Jun	2,756	2,159	3,354
25-Jun	6,280	4,985	7,575
26-Jun	3,218	2,529	3,907
27-Jun	4,433	3,504	5,363
28-Jun	3,116	2,448	3,785
29-Jun	2,600	2,034	3,167
30-Jun	659	482	835
	583,985	436,166	731,804

Appendix B.2. Akalura Lake daily sockeye salmon smolt population estimates, 1993.

Date	Population Estimate	95% CI Lower	95% CI Upper
03-May	1,134	16[a]	2,284
04-May	729	24[a]	1,482
05-May	324	31[a]	679
06-May	324	31[a]	679
07-May	162	32[a]	356
08-May	243	32[a]	518
09-May	567	27[a]	1,161
10-May	243	32[a]	518
11-May	324	31[a]	679
12-May	729	24[a]	1,482
13-May	891	21[a]	1,803
14-May	1,134	16[a]	2,284
15-May	1,539	8[a]	3,086
16-May	1,620	7[a]	3,247
17-May	4,698	55	9,341
18-May	8,424	130	16,718
19-May	3,273	73	6,474
20-May	3,346	160	6,532
21-May	869	47	1,690
22-May	2,913	1,260	4,567
23-May	6,283	2,776	9,790
24-May	10,548	4,696	16,401
25-May	5,636	3,157	8,116
26-May	2,214	1,176	3,253
27-May	3,997	2,207	5,787
28-May	4,249	3,401	5,097
29-May	3,731	2,980	4,482
30-May	3,621	2,890	4,351
31-May	5,376	4,317	6,435
01-Jun	2,386	1,887	2,886
02-Jun	1,417	1,100	1,733
03-Jun	924	701	1,147
04-Jun	632	466	797
05-Jun	605	418	791
06-Jun	605	418	791
07-Jun	625	433	816
08-Jun	525	359	691
09-Jun	346	225	466
10-Jun	432	289	575
11-Jun	213	128	297
12-Jun	233	142	323
13-Jun	206	123	289
14-Jun	106	52	160
15-Jun	106	52	160
16-Jun	106	52	160
17-Jun	120	62	178
18-Jun	66	26	107
19-Jun	47	13	80
20-Jun	33	6	61

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Appendix B.2. (page 2 of 2)

Date	Population Estimate	95% CI Lower	95% CI Upper
21-Jun	0	0	0
22-Jun	0	0	0
23-Jun	0	0	0
24-Jun	0	0	0
25-Jun	0	0	0
26-Jun	0	0	0
27-Jun	0	0	0
28-Jun	0	0	0
29-Jun	0	0	0
30-Jun	0	0	0
01-Jul	0	0	0
	88,873	35,943	141,802

[a] Numbers are negative values.

Appendix B.3. Upper Station daily sockeye salmon smolt population estimates, 1993.

Date	Population Estimate	95% CI	
		Lower	Upper
04-May	0	0	0
05-May	0	0	0
06-May	0	0	0
07-May	0	0	0
08-May	0	0	0
09-May	0	0	0
10-May	38	6	70
11-May	266	166	366
12-May	6,015	4,636	7,394
13-May	6,875	5,306	8,443
14-May	10,890	8,438	13,342
15-May	9,011	6,973	11,050
16-May	7,605	5,876	9,333
17-May	4,048	3,079	5,017
18-May	4,792	3,626	5,959
19-May	8,869	6,701	11,037
20-May	4,361	3,234	5,488
21-May	6,689	4,943	8,436
22-May	16,660	12,273	21,047
23-May	48,233	35,248	61,219
24-May	132,910	96,461	169,359
25-May	13,511	9,742	17,281
26-May	8,383	6,017	10,749
27-May	6,968	4,962	8,975
28-May	9,201	6,536	11,865
29-May	3,016	2,081	3,951
30-May	9,258	6,495	12,021
31-May	32,261	22,674	41,849
01-Jun	54,066	37,792	70,340
02-Jun	39,954	27,707	52,200
03-Jun	36,920	25,647	48,194
04-Jun	34,516	23,972	45,061
05-Jun	39,705	27,587	51,823
06-Jun	72,056	49,392	94,721
07-Jun	25,670	17,251	34,089
08-Jun	13,187	8,652	17,721
09-Jun	4,826	3,040	6,611
10-Jun	15,037	9,431	20,644
11-Jun	8,783	5,309	12,256
12-Jun	10,501	6,368	14,634
13-Jun	9,308	5,632	12,983
14-Jun	17,231	10,515	23,947
15-Jun	34,605	21,222	47,989
16-Jun	43,889	26,943	60,835
17-Jun	32,434	19,883	44,984
18-Jun	17,138	13,474	20,802
19-Jun	10,512	8,243	12,781
20-Jun	14,082	11,062	17,103
21-Jun	7,921	6,289	9,552

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Appendix B.3. (page 2 of 2)

Date	Population Estimate	95% CI	
		Lower	Upper
22-Jun	34,343	27,787	40,899
23-Jun	26,954	22,038	31,871
24-Jun	23,819	19,660	27,978
25-Jun	59,455	49,573	69,338
26-Jun	19,239	16,141	22,337
27-Jun	25,443	21,359	29,526
28-Jun	15,889	13,323	18,455
29-Jun	48,974	40,853	57,094
30-Jun	65,798	54,468	77,128
01-Jul	22,870	18,736	27,004
02-Jul	79,719	64,794	94,643
03-Jul	64,475	51,588	77,362
04-Jul	63,987	51,197	76,776
05-Jul	101,021	80,858	121,183
06-Jul	116,182	93,250	139,115
07-Jul	49,418	39,738	59,098
08-Jul	175,942	141,965	209,919
09-Jul	458,029	370,564	545,494
10-Jul	121,847	98,779	144,914
11-Jul	117,126	95,172	139,079
12-Jul	18,060	14,669	21,452
13-Jul	8,790	7,131	10,448
14-Jul	19,339	15,780	22,897
15-Jul	23,426	19,167	27,686
16-Jul	106,160	87,199	125,122
17-Jul	81,599	67,150	96,048
18-Jul	14,541	11,954	17,129
19-Jul	18,685	15,403	21,968
20-Jul	31,150	25,757	36,544
21-Jul	40,131	32,796	47,467
22-Jul	56,438	46,139	66,738
23-Jul	53,733	43,925	63,541
24-Jul	34,140	27,894	40,387
25-Jul	35,305	28,897	41,713
26-Jul	23,162	18,977	27,347
27-Jul	51,920	42,660	61,180
28-Jul	14,960	12,284	17,636
29-Jul	29,231	24,626	33,835
30-Jul	38,220	32,213	44,227
31-Jul	22,137	18,640	25,635
01-Aug	30,823	26,075	35,570
02-Aug	31,110	26,419	35,801
03-Aug	8,498	7,213	9,782
04-Aug	13,151	11,225	15,076
05-Aug	12,198	10,411	13,984
06-Aug	10,283	8,771	11,794
07-Aug	8,908	7,594	10,223
08-Aug	19,538	16,700	22,377
09-Aug	23,689	20,256	27,121
	3,462,058	2,720,652	4,203,464

Appendix B.4. Frazer Lake daily sockeye salmon smolt population estimates, 1991.[a]

Date	Population Estimate	95% CI	
		Lower	Upper
05-May	0	0	0
06-May	0	0	0
07-May	0	0	0
08-May	0	0	0
09-May	0	0	0
10-May	0	0	0
11-May	0	0	0
12-May	0	0	0
13-May	0	0	0
14-May	0	0	0
15-May	2,491	102	4,879
16-May	2,179	40	4,318
17-May	2,491	102	4,879
18-May	14,009	2,562	25,456
19-May	42,339	8,701	75,976
20-May	3,736	358	7,114
21-May	0	0	0
22-May	69,423	14,576	124,270
23-May	1,745,841	378,266	3,113,415
24-May	0	0	0
25-May	623	222[b]	1,467
26-May	311	234[b]	856
27-May	300	112[b]	711
28-May	28,397	12,827	43,966
29-May	107,082	55,723	158,441
30-May	75,302	42,389	108,216
31-May	12,483	6,842	18,123
01-Jun	29,610	16,532	42,688
02-Jun	92,055	49,259	134,851
03-Jun	240	38[b]	517
04-Jun	90,905	41,582	140,227
05-Jun	342,515	138,339	546,690
06-Jun	2,281,779	720,004	3,843,554
07-Jun	1,280	86	2,473
08-Jun	133,448	41,756	225,140
09-Jun	332,250	118,345	546,155
10-Jun	130,657	50,935	210,378
11-Jun	41,469	17,216	65,723
12-Jun	86,240	38,394	134,087
13-Jun	168,734	80,791	256,677
14-Jun	110,133	52,637	167,628
15-Jun	67,971	32,381	103,561
16-Jun	10,627	5,280	15,974
17-Jun	557	134	979
18-Jun	807	293	1,320
19-Jun	190	2[b]	382
20-Jun	3,196	1,801	4,592
21-Jun	134,336	85,327	183,345
22-Jun	10,306	6,541	14,072

-Continued-

Date	Population Estimate	95% CI Lower	95% CI Upper
23-Jun	1,625	931	2,319
24-Jun	3,494	2,210	4,777
25-Jun	9,512	6,383	12,641
26-Jun	41,682	28,899	54,465
27-Jun	38,731	27,494	49,969
28-Jun	18,860	13,312	24,409
29-Jun	4,487	3,059	5,915
30-Jun	16,419	11,570	21,269
01-Jul	8,407	5,853	10,961
02-Jul	1,553	976	2,130
03-Jul	4,808	3,287	6,328
04-Jul	3,427	2,304	4,549
05-Jul	2,022	1,307	2,736
06-Jul	1,011	597	1,425
07-Jul	419	194	645
08-Jul	567	292	842
09-Jul	518	259	776
10-Jul	173	41	305
11-Jul	25	22[b]	71
12-Jul	0	0	0
13-Jul	0	0	0
14-Jul	0	0	0
15-Jul	0	0	0
	6,334,047	2,128,460	10,539,634

[a] Preliminary estimates subject to further analysis.
[b] Numbers are negative values.

Appendix B.5. Frazer Lake daily sockeye salmon smolt population estimates, 1992.[a]

Date	Population Estimate	95% CI	
		Lower	Upper
05-May	0	0	0
06-May	0	0	0
07-May	0	0	0
08-May	0	0	0
09-May	6,105	144[b]	12,354
10-May	20,535	141	40,929
11-May	5,550	154[b]	11,254
12-May	3,330	195[b]	6,855
13-May	13,875	8	27,742
14-May	53,280	794	105,766
15-May	396,825	7,665	785,985
16-May	673,770	13,205	1,334,335
17-May	83,805	1,405	166,205
18-May	6,718	999	12,437
19-May	5,497	738	10,255
20-May	216,206	46,431	385,980
21-May	372,596	127,357	617,835
22-May	58,078	24,341	91,816
23-May	164,474	78,752	250,196
24-May	133,329	63,788	202,870
25-May	215,741	103,384	328,098
26-May	32,299	18,393	46,204
27-May	1,904	1,042	2,766
28-May	23,189	15,456	30,922
29-May	206,428	144,959	267,896
30-May	31,318	22,946	39,690
31-May	467,826	344,715	590,937
01-Jun	397,139	292,608	501,669
02-Jun	2,890	1,952	3,828
03-Jun	14,364	9,993	18,736
04-Jun	43,518	29,724	57,312
05-Jun	3,005	1,823	4,187
06-Jun	171,776	108,531	235,022
07-Jun	1,327,373	683,791	1,970,955
08-Jun	225,999	116,270	335,729
09-Jun	82,498	42,326	122,671
10-Jun	27,306	13,603	41,010
11-Jun	2,476	1,042	3,909
12-Jun	3,322	1,414	5,230
13-Jun	16,138	7,383	24,893
14-Jun	152,142	69,272	235,012
15-Jun	177,538	91,019	264,058
16-Jun	9,650	4,711	14,588
17-Jun	4,674	2,160	7,188
18-Jun	15,512	7,266	23,759
19-Jun	7,029	2,892	11,166
20-Jun	11,486	4,403	18,568
21-Jun	74,143	25,860	122,425
22-Jun	35,029	12,032	58,026

-Continued-

Date	Population Estimate	95% CI Lower	95% CI Upper
23-Jun	49,481	17,141	81,820
24-Jun	44,925	15,531	74,320
25-Jun	828	5[b]	1,661
26-Jun	9,639	2,816	16,461
27-Jun	7,067	1,871	12,263
28-Jun	1,387	85	2,688
29-Jun	85,158	24,211	146,106
30-Jun	73,882	15,679	132,084
01-Jul	29,458	6,030	52,885
02-Jul	13,779	2,628	24,930
03-Jul	29,458	6,030	52,885
04-Jul	37,772	7,836	67,709
05-Jul	16,629	3,246	30,013
06-Jul	4,039	525	7,552
07-Jul	475	169[b]	1,119
08-Jul	0	0	0
09-Jul	2,613	225	5,002
10-Jul	0	0	0
11-Jul	950	102[b]	2,002
12-Jul	0	0	0
	6,405,222	2,649,678	10,160,766

[a] Preliminary estimates subject to further analysis.
[b] Numbers are negative values.

Appendix B.6. Frazer Lake daily sockeye salmon smolt population estimates, 1993.

Date	Population Estimate	95% CI Lower	95% CI Upper
06-May	0	0	0
07-May	515	175[a]	1,205
08-May	257	179[a]	694
09-May	0	0	0
10-May	0	0	0
11-May	0	0	0
12-May	515	175[a]	1,205
13-May	2,574	86	5,062
14-May	10,298	1,248	19,348
15-May	31,151	4,422	57,880
16-May	5,664	546	10,781
17-May	78,263	11,601	144,926
18-May	107,948	17,886	198,011
19-May	318,916	58,429	579,403
20-May	154,513	30,464	278,561
21-May	403,103	85,708	720,497
22-May	66,501	23,154	109,849
23-May	171,888	60,412	283,364
24-May	68,723	23,939	113,507
25-May	22,785	7,787	37,784
26-May	152,734	54,755	250,713
27-May	106,469	38,442	174,496
28-May	655,695	240,846	1,070,544
29-May	1,417,219	546,535	2,287,902
30-May	467,806	180,165	755,446
31-May	814,447	313,931	1,314,962
01-Jun	42,890	16,125	69,655
02-Jun	1,043,564	398,909	1,688,219
03-Jun	165,282	62,602	267,962
04-Jun	36,698	13,559	59,837
05-Jun	1,089,123	419,847	1,758,398
06-Jun	304,462	117,102	491,822
07-Jun	732,090	282,093	1,182,087
08-Jun	289,678	102,198	477,158
09-Jun	200,197	63,103	337,291
10-Jun	104,014	28,028	180,001
11-Jun	33,496	6,926	60,066
12-Jun	90,662	13,193	168,131
13-Jun	187,734	27,938	347,531
14-Jun	141,030	20,843	261,216
15-Jun	59,983	8,533	111,434
16-Jun	45,331	6,308	84,354
17-Jun	68,683	9,854	127,512
18-Jun	66,394	9,507	123,281
19-Jun	22,437	2,835	42,039
20-Jun	7,326	555	14,097
	9,789,057	3,309,885	16,268,229

[a] Numbers are negative values.

Appendix C.1. Red Lake sockeye salmon smolt emigration by age class, 1993.

Dates	Population Estimate	Ages 1.0	2.0	3.0
5/07-5/09/93	105	0	0	105
5/10-5/16/93	3,575	32	805	2,738
5/17-5/23/93	26,792	0	9,101	17,691
5/24-5/30/93	210,508	5,648	139,141	65,720
5/31-6/06/93	133,766	93,830	39,548	388
6/07-6/13/93	108,720	105,605	3,115	0
6/14-6/20/93	59,318	58,634	684	0
6/21-6/27/93	34,825	33,428	1,397	0
6/28-6/30/93	6,376	6,285	91	0
Total	583,985	303,462	193,882	86,642

Appendix C.2. Akalura Lake sockeye salmon smolt emigration by age class, 1993.

Dates	Population Estimate	Ages 1.0	2.0	3.0	4.0
5/03-5/09/93	3,483	0	2,516	968	0
5/10-5/16/93	6,480	0	3,848	2,633	0
5/17-5/23/93	29,806	2,384	20,387	6,796	238
5/24-5/30/93	33,996	143	31,988	1,865	0
5/31-6/06/93	11,945	301	11,601	43	0
6/07-6/13/93	2,580	283	2,287	10	0
6/14-6/20/93	583	148	435	0	0
Total	88,873	3,259	73,062	12,315	238

Appendix C.3. Upper Station sockeye salmon smolt emigration by age class, 1993.

Dates	Population Estimate	Ages 0.0	1.0	2.0	3.0
5/05-5/09/93	0	0	0	0	0
5/10-5/16/93	40,700	0	7,814	31,583	1,302
5/17-5/23/93	93,652	0	23,161	67,470	3,021
5/24-5/30/93	183,247	0	56,545	124,084	2,618
5/31-6/06/93	309,478	0	224,994	82,705	1,779
6/07-6/13/93	87,312	0	71,346	15,716	249
6/14-6/20/93	169,891	7,323	133,765	27,827	976
6/21-6/27/93	197,174	159,993	33,801	3,380	0
6/28-7/04/93	361,712	351,377	8,268	2,067	0
7/05-7/11/93	1,139,565	1,136,309	3,256	0	0
7/12-7/18/93	271,915	271,915	0	0	0
7/19-7/25/93	269,582	264,190	5,392	0	0
7/26-8/01/93	210,453	210,453	0	0	0
8/02-8/09/93	127,377	127,377	0	0	0
Total	3,462,058	2,528,937	568,342	354,833	9,946

Appendix C.4. Frazer Lake sockeye salmon smolt emigration by age class, 1991.

Dates	Population Estimate	Ages 1.0	2.0	3.0
5/05-5/09/91	0	0	0	0
5/10-5/16/91	4,670	2,172	2,498	0
5/17-5/23/91	1,877,839	873,195	1,004,644	0
5/24-5/30/91	212,015	93,892	118,123	0
5/31-6/06/91	2,849,587	1,058,220	1,791,367	0
6/07-6/13/91	894,078	399,064	492,833	2,181
6/14-6/20/91	193,481	61,525	131,956	0
6/21-6/27/91	239,686	53,327	185,212	1,147
6/28-7/04/91	57,961	10,577	46,961	423
7/05-7/11/91	4,730	863	3,832	35
7/12-7/15/91	0	0	0	0
Total	6,334,047	2,552,835	3,777,426	3,786

[a] Preliminary estimates subject to further analysis.

Appendix C.5. Frazer Lake sockeye salmon smolt emigration by age class, 1992[a].

Dates	Population Estimate	Ages 1.0	2.0	3.0
5/05-5/09/92	6,105	470	3,287	2,348
5/10-5/16/92	1,167,165	11,406	840,207	315,553
5/17-5/23/92	907,374	17,968	752,402	137,004
5/24-5/30/92	644,208	7,724	613,311	23,173
5/31-6/06/92	1,100,518	13,356	1,073,806	13,356
6/07-6/13/92	1,685,112	46,927	1,578,459	59,725
6/14-6/20/92	378,031	2,938	369,217	5,876
6/21-6/27/92	221,112	3,841	216,723	549
6/28-7/07/92	270,894	3,859	267,035	0
7/05-7/11/92	24,703	0	24,703	0
7/12-7/15/92	0	0	0	0
Total	6,405,222	108,489	5,739,150	557,584

[a] Preliminary estimates subject to further analysis.

Appendix C.6. Frazer Lake sockeye salmon smolt emigration by age class, 1993.

Dates	Population Estimate	Ages			
		1.0	2.0	3.0	4.0
5/05-5/09/93	772	0	16	756	0
5/10-5/16/93	50,202	0	4,081	45,508	612
5/17-5/23/93	1,301,132	0	356,218	944,914	0
5/24-5/30/93	2,891,431	0	1,129,985	1,761,446	0
5/31-6/06/93	3,496,466	0	2,024,932	1,471,534	0
6/07-6/13/93	1,637,871	0	1,204,317	433,554	0
6/14-6/20/93	411,183	23,496	358,317	29,370	0
Total	9,789,057	23,496	5,077,866	4,687,083	612

Appendix D.1. Mean length, weight, and condition factor of Red Lake sockeye salmon smolt samples and population by age and date, 1993.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
1	5/10-5/16	1	92.0		1	5.6		1	0.72		32	92.0	5.6	0.72
1	5/24-5/30	11	88.4	3.8	11	6.1	0.9	11	0.82	0.03	5,648	88.4	6.1	0.82
1	5/31-6/06	242	92.2	0.3	242	7.4	0.1	242	0.94	0.01	93,830	92.2	7.4	0.94
1	6/07-6/13	339	91.8	0.2	339	7.8	0.1	339	1.01	0.00	105,605	91.8	7.8	1.01
1	6/14-6/20	343	91.1	0.2	343	7.1	0.1	343	0.94	0.00	58,634	91.1	7.1	0.94
1	6/21-6/27	335	91.7	0.2	335	7.5	0.1	335	0.98	0.00	33,428	91.7	7.5	0.98
1	6/28-7/04	138	91.9	0.3	138	5.7	0.1	138	0.73	0.00	6,285	91.9	5.7	0.73
	Totals	1,409	91.7	0.1	1,409	7.3	0.0	1,409	0.94	0.00	303,462	91.7	7.4	0.96
2	5/10-5/16	25	108.4	1.7	25	10.0	0.5	25	0.77	0.01	805	108.4	10.0	0.77
2	5/17-5/23	89	111.3	1.1	89	11.5	0.3	89	0.81	0.01	9,101	111.3	11.5	0.81
2	5/24-5/30	271	112.9	0.5	271	12.0	0.2	271	0.83	0.00	139,141	112.9	12.0	0.83
2	5/31-6/06	101	99.2	1.1	102	8.8	0.3	101	0.89	0.01	39,548	99.2	8.8	0.89
2	6/07-6/13	10	92.8	1.5	10	8.2	0.4	10	1.02	0.02	3,115	92.8	8.2	1.02
2	6/14-6/20	4	94.0	3.1	4	8.0	0.7	4	0.96	0.03	684	94.0	8.0	0.96
2	6/21-6/27	14	93.5	1.5	14	8.4	0.2	14	1.03	0.02	1,397	93.5	8.4	1.03
2	6/28-7/04	2	90.5	1.5	2	5.8	0.8	2	0.79	0.06	91	90.5	5.8	0.79
	Totals	516	108.6	0.5	517	11.0	0.1	516	0.84	0.00	193,882	109.5	11.2	0.85
3	5/03-5/09	10	118.1	3.6	9	14.1	1.1	9	0.80	0.02	105	118.1	14.1	0.80
3	5/10-5/16	85	121.4	1.3	85	14.7	0.5	85	0.79	0.00	2,738	121.4	14.7	0.79
3	5/17-5/23	173	121.8	0.8	172	15.2	0.3	172	0.83	0.00	17,691	121.8	15.2	0.83
3	5/24-5/30	128	117.1	0.9	128	13.4	0.3	128	0.82	0.01	65,720	117.1	13.4	0.82
3	5/31-6/06	1	108.0		1	8.6		1	0.68		388	108.0	8.6	0.68
	Totals	397	120.1	0.6	395	14.5	0.2	395	0.82	0.00	86,642	118.2	13.8	0.82

Appendix D.2. Mean length, weight, and condition factor of Akalura Lake sockeye salmon smolt samples and population by age and date, 1993.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
1	5/17-5/23	20	51.6	0.8	20	1.1	0.1	20	0.81	0.03	2,384	51.6	1.1	0.81
1	5/24-5/30	1	52.0		1	1.2		1	0.85		143	52.0	1.2	0.85
1	5/31-6/06	7	60.4	2.3	7	1.9	0.2	7	0.86	0.04	301	60.4	1.9	0.86
1	6/07-6/13	29	64.2	1.8	29	2.4	0.2	29	0.84	0.01	283	64.2	2.4	0.84
1	6/14-6/20	17	70.7	1.8	17	3.1	0.3	17	0.85	0.02	148	70.7	3.1	0.85
	Totals	74	61.8	1.2	74	2.2	0.1	74	0.84	0.01	3,259	54.4	1.4	0.82
2	5/03-5/09	26	82.6	1.1	25	5.0	0.3	25	0.86	0.02	2,516	82.6	5.0	0.86
2	5/10-5/16	19	81.8	1.3	19	5.0	0.2	19	0.90	0.02	3,848	81.8	5.0	0.90
2	5/17-5/23	171	85.0	0.3	171	5.5	0.1	171	0.89	0.00	20,387	85.0	5.5	0.89
2	5/24-5/30	222	84.7	0.3	223	5.7	0.1	222	0.93	0.01	31,988	84.7	5.7	0.93
2	5/31-6/06	270	86.1	0.3	270	5.8	0.1	270	0.89	0.00	11,601	86.1	5.8	0.89
2	6/07-6/13	234	87.5	0.4	234	6.1	0.1	234	0.89	0.00	2,287	87.5	6.1	0.89
2	6/14-6/20	50	86.7	0.9	50	6.0	0.2	50	0.90	0.01	435	86.7	6.0	0.90
	Totals	992	85.8	0.2	992	5.7	0.0	991	0.90	0.00	73,062	84.9	5.6	0.91
3	5/03-5/09	10	90.8	1.8	10	6.2	0.3	10	0.82	0.01	968	90.8	6.2	0.82
3	5/10-5/16	13	89.5	3.6	13	6.8	1.0	13	0.90	0.02	2,633	89.5	6.8	0.90
3	5/17-5/23	57	90.5	0.7	57	6.7	0.1	57	0.90	0.01	6,796	90.5	6.7	0.90
3	5/24-5/30	12	92.5	1.1	12	7.2	0.3	12	0.91	0.02	1,865	92.5	7.2	0.91
3	5/31-6/06	1	94.0		1	7.1		1	0.85		43	94.0	7.1	0.85
3	6/07-6/13	1	97.0		1	8.7		1	0.95		10	97.0	8.7	0.95
	Totals	94	90.8	0.7	94	6.8	0.2	94	0.89	0.01	12,315	90.6	6.8	0.90
4	5/17-5/23	2	101.5	2.5	2	10.1	0.5	2	0.97	0.03	238	101.5	10.1	0.97
	Totals	2	101.5	2.5	2	10.1	0.5	2	0.97	0.03	238	101.5	10.1	0.97

Appendix D.3. Mean length, weight, and condition factor of Upper Station Lake sockeye salmon smolt samples and population by age and date, 1993.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
0	6/14-6/20	15	62.7	1.2	15	2.2	0.1	15	0.88	0.02	7,323	62.7	2.2	0.88
0	6/21-6/27	284	62.1	0.3	284	2.2	0.0	284	0.90	0.01	159,993	62.1	2.2	0.90
0	6/28-7/04	340	61.3	0.3	340	2.1	0.0	340	0.88	0.00	351,377	61.3	2.1	0.88
0	7/05-7/11	349	56.9	0.3	349	1.6	0.0	349	0.86	0.00	1,136,309	56.9	1.6	0.86
0	7/12-7/18	350	56.7	0.3	350	1.7	0.0	350	0.90	0.00	271,915	56.7	1.7	0.90
0	7/19-7/25	343	60.1	0.3	343	2.1	0.0	343	0.93	0.00	264,190	60.1	2.1	0.93
0	7/26-8/01	350	62.6	0.2	350	2.4	0.0	350	0.97	0.00	210,453	62.6	2.4	0.97
0	8/02-8/08	280	64.5	0.2	280	2.5	0.0	280	0.94	0.00	127,377	64.5	2.5	0.94
	Totals	2,311	60.5	0.1	2,311	2.1	0.0	2,311	0.91	0.00	2,528,937	59.0	1.9	0.89
1	5/10-5/16	48	88.1	0.7	48	5.1	0.1	48	0.74	0.01	7,814	88.1	5.1	0.74
1	5/17-5/23	69	89.3	0.6	69	5.5	0.1	69	0.76	0.01	23,161	89.3	5.5	0.76
1	5/24-5/30	108	90.9	0.6	107	5.9	0.1	107	0.77	0.00	56,545	90.9	5.9	0.77
1	5/31-6/06	253	90.3	0.3	253	5.9	0.1	253	0.79	0.00	224,994	90.3	5.9	0.79
1	6/07-6/13	285	93.0	0.3	286	6.6	0.1	285	0.81	0.00	71,346	93.0	6.6	0.81
1	6/14-6/20	274	93.6	0.3	274	6.8	0.1	274	0.82	0.00	133,765	93.6	6.8	0.82
1	6/21-6/27	60	93.9	0.5	60	7.0	0.1	60	0.84	0.01	33,801	93.9	7.0	0.84
1	6/28-7/04	8	93.1	2.9	8	7.0	0.5	8	0.86	0.03	8,268	93.1	7.0	0.86
1	7/05-7/11	1	95.0		1	7.3		1	0.85		3,256	95.0	7.3	0.85
1	7/19-7/25	7	103.3	2.1	7	9.7	0.7	7	0.88	0.02	5,392	103.3	9.7	0.88
	Totals	1,113	92.0	0.2	1,113	6.3	0.0	1,112	0.80	0.00	568,342	91.8	6.3	0.80
2	5/10-5/16	194	114.1	0.7	194	12.4	0.2	194	0.82	0.00	31,583	114.1	12.4	0.82
2	5/17-5/23	201	116.2	0.8	200	13.3	0.3	200	0.82	0.00	67,470	116.2	13.3	0.82
2	5/24-5/30	237	113.9	0.7	237	12.4	0.2	237	0.82	0.00	124,084	113.9	12.4	0.82
2	5/31-6/06	93	103.4	1.1	93	9.4	0.3	93	0.82	0.00	82,705	103.4	9.4	0.82
2	6/07-6/13	63	101.7	1.4	63	9.1	0.4	63	0.83	0.01	15,716	101.7	9.1	0.83
2	6/14-6/20	57	98.6	1.4	57	8.1	0.4	57	0.81	0.01	27,827	98.6	8.1	0.81
2	6/21-6/27	6	112.3	5.9	6	11.5	1.9	6	0.77	0.02	3,380	112.3	11.5	0.77
2	6/28-7/04	2	94.5	6.5	2	6.6	1.5	2	0.76	0.03	2,067	94.5	6.6	0.76
	Totals	853	111.4	0.4	852	11.7	0.1	852	0.82	0.00	354,833	110.0	11.3	0.82
3	5/10-5/16	8	117.9	5.4	8	14.3	1.9	8	0.84	0.02	1,302	117.9	14.3	0.84
3	5/17-5/23	9	122.9	3.3	9	15.9	1.2	9	0.84	0.01	3,021	122.9	15.9	0.84
3	5/24-5/30	5	127.0	1.5	5	17.3	0.7	5	0.84	0.01	2,618	127.0	17.3	0.84
3	5/31-6/06	2	123.5	13.5	2	16.1	5.9	2	0.81	0.04	1,779	123.5	16.1	0.81
3	6/07-6/13	1	96.0		1	7.0		1	0.79		249	96.0	7.0	0.79
3	6/14-6/20	2	101.5	1.5	2	8.9	0.7	2	0.85	0.02	976	101.5	8.9	0.85
	Totals	27	119.6	2.5	27	14.9	0.9	27	0.84	0.01	9,946	120.6	15.2	0.83

Appendix D.4. Mean length, weight, and condition factor of Frazer Lake sockeye salmon smolt samples and population by age and date, 1991.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
1	5/15-5/23	93	92.9	0.5	92	5.9	0.1	92	0.74	0.01	875,367	92.9	5.9	0.74
1	5/24-5/30	124	91.9	0.4	124	5.7	0.1	124	0.73	0.01	93,892	91.9	5.7	0.73
1	5/31-6/06	153	91.4	0.3	153	5.6	0.1	153	0.73	0.00	1,058,220	91.4	5.6	0.73
1	6/07-6/13	183	88.2	0.2	183	5.1	0.0	183	0.74	0.00	399,064	88.2	5.1	0.74
1	6/14-6/20	76	85.8	0.4	76	4.6	0.1	76	0.72	0.01	61,525	85.8	4.6	0.72
1	6/21-6/27	93	88.0	0.6	93	5.5	0.1	93	0.79	0.01	53,327	88.0	5.5	0.79
1	6/28-7/11	24	86.8	1.1	24	5.3	0.3	24	0.80	0.01	11,440	86.8	5.3	0.80
	Totals	746	89.7	0.2	745	5.4	0.0	745	0.74	0.00	2,552,835	91.2	5.6	0.74
2	5/15-5/23	107	95.4	0.5	106	6.5	0.1	106	0.75	0.00	1,007,142	95.4	6.5	0.75
2	5/24-5/30	156	92.2	0.5	156	5.8	0.1	156	0.74	0.00	118,123	92.2	5.8	0.74
2	5/31-6/06	259	91.4	0.2	259	5.7	0.0	259	0.74	0.00	1,791,367	91.4	5.7	0.74
2	6/07-6/13	226	87.9	0.2	226	5.1	0.0	226	0.75	0.00	492,833	87.9	5.1	0.75
2	6/14-6/20	163	85.8	0.3	163	4.8	0.1	163	0.75	0.00	131,956	85.8	4.8	0.75
2	6/21-6/27	322	88.4	0.4	322	5.7	0.1	322	0.81	0.00	185,212	88.4	5.7	0.81
2	6/28-7/11	111	87.4	0.6	111	5.6	0.2	111	0.82	0.01	50,793	87.4	5.6	0.82
	Totals	1,344	89.5	0.2	1,343	5.6	0.0	1,343	0.77	0.00	3,777,426	91.6	5.8	0.75
3	6/07-6/13	1	109.0	0.0	1	10.9	0.0	1	0.84	0.00	2,181	109.0	10.9	0.84
3	6/21-6/27	2	113.0	1.0	2	12.4	0.1	2	0.86	0.03	1,147	113.0	12.4	0.86
3	6/28-7/11	1	148.0	0.0	1	27.3	0.0	1	0.84	0.00	458	148.0	27.3	0.84
	Totals	4	120.8	9.1	4	15.7	3.9	4	0.85	0.01	3,785	115.0	13.3	0.85

Appendix D.5. Mean length, weight, and condition factor of Frazer Lake sockeye salmon smolt samples and population by age and date, 1992.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
1	5/03-5/09	2	85.5	1.5	2	5.3	0.3	2	0.84	0.01	470	85.5	5.3	0.84
1	5/10-5/16	3	82.3	1.8	3	4.9	0.2	3	0.87	0.05	11,406	82.3	4.9	0.87
1	5/17-5/23	8	85.8	1.6	8	5.8	0.3	8	0.92	0.02	17,968	85.8	5.8	0.92
1	5/24-5/30	5	79.0	3.7	5	4.7	0.6	5	0.94	0.02	7,724	79.0	4.7	0.94
1	5/31-6/06	5	82.8	1.9	5	5.5	0.4	5	0.96	0.02	13,356	82.8	5.5	0.96
1	6/07-6/13	11	86.4	2.5	11	6.8	0.6	11	1.03	0.02	46,927	86.4	6.8	1.03
1	6/14-6/20	3	95.0	7.5	3	9.3	0.2	3	1.18	0.31	2,938	95.0	9.3	1.18
1	6/21-6/27	7	89.9	1.9	7	5.9	0.4	7	0.81	0.02	3,841	89.9	5.9	0.81
1	6/28-7/04	5	91.6	1.7	5	6.4	0.3	5	0.83	0.02	3,859	91.6	6.4	0.83
	Totals	49	86.4	1.1	49	6.1	0.2	49	0.94	0.02	108,489	85.4	6.1	0.97
2	5/03-5/09	14	85.6	1.9	14	5.7	0.4	14	0.89	0.02	3,287	85.6	5.7	0.89
2	5/10-5/16	220	86.0	0.4	221	6.0	0.1	220	0.93	0.01	840,207	86.0	6.0	0.93
2	5/17-5/23	335	85.3	0.3	335	5.8	0.1	335	0.94	0.00	752,402	85.3	5.8	0.94
2	5/24-5/30	391	80.6	0.2	396	5.0	0.0	390	0.95	0.00	613,311	80.6	5.0	0.95
2	5/31-6/06	401	80.2	0.2	400	5.1	0.0	399	0.97	0.00	1,073,806	80.2	5.1	0.97
2	6/07-6/13	370	79.7	0.4	363	5.4	0.1	363	1.05	0.01	1,578,459	79.7	5.4	1.05
2	6/14-6/20	376	85.8	0.4	375	5.8	0.1	374	0.91	0.01	369,217	85.8	5.8	0.91
2	6/21-6/27	395	86.0	0.2	393	5.3	0.0	393	0.82	0.00	216,723	86.0	5.3	0.82
2	6/28-7/04	345	88.2	0.2	346	5.7	0.0	345	0.83	0.00	267,035	88.2	5.7	0.83
2	7/05-7/11	104	87.3	0.3	104	5.7	0.1	104	0.85	0.01	24,703	87.3	5.7	0.85
	Totals	2,951	83.9	0.1	2,947	5.5	0.0	2,937	0.92	0.00	5,739,150	82.6	5.5	0.96
3	5/03-5/09	10	89.9	1.9	10	6.6	0.4	10	0.90	0.03	2,348	89.9	6.6	0.90
3	5/10-5/16	83	91.8	0.6	83	7.2	0.2	83	0.93	0.01	315,553	91.8	7.2	0.93
3	5/17-5/23	58	90.3	0.7	61	7.0	0.2	58	0.94	0.01	137,004	90.3	7.0	0.94
3	5/24-5/30	14	82.4	1.2	15	5.4	0.3	14	0.93	0.02	23,173	82.4	5.4	0.93
3	5/31-6/06	5	91.6	3.6	5	7.9	1.2	5	0.99	0.04	13,356	91.6	7.9	0.99
3	6/07-6/13	14	96.6	2.8	13	9.0	0.7	13	0.96	0.03	59,725	96.6	9.0	0.96
3	6/14-6/20	6	99.5	4.8	6	8.9	1.2	6	0.88	0.04	5,876	99.5	8.9	0.88
3	6/21-6/27	1	84.0	0.0	1	4.6	0.0	1	0.78	0.00	549	84.0	4.6	0.78
	Totals	191	91.1	0.5	194	7.2	0.1	190	0.93	0.01	557,584	91.6	7.3	0.94

Appendix D.6. Mean length, weight, and condition factor of Frazer Lake sockeye salmon smolt samples and population by age and date, 1993.

		Length			Weight			Condition			Population			
Age	Dates	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Population Size	Mean Length	Mean Weight	Mean Condition
1	6/14-6/20	8	89.9	0.5	8	6.1	0.2	8	0.83	0.01	23,496	89.9	6.1	0.83
	Totals	8	89.9	0.5	8	6.1	0.2	8	0.83	0.01	23,496	89.9	6.1	0.83
2	5/03-5/09	1	99.0		1	7.6		1	0.78		16	99.0	7.6	0.78
2	5/10-5/16	20	100.1	0.8	19	8.3	0.2	19	0.83	0.01	4,081	100.1	8.3	0.83
2	5/17-5/23	94	99.6	0.3	95	8.1	0.1	94	0.82	0.01	356,218	99.6	8.1	0.82
2	5/24-5/30	134	101.8	0.4	136	8.8	0.1	134	0.84	0.01	1,129,985	101.8	8.8	0.84
2	5/31-6/06	161	99.8	0.2	161	8.2	0.1	161	0.82	0.00	2,024,932	99.8	8.2	0.82
2	6/07-6/13	150	99.9	0.3	150	8.1	0.1	150	0.81	0.01	1,204,317	99.9	8.1	0.81
2	6/14-6/20	122	100.2	0.3	122	8.2	0.1	122	0.81	0.01	358,317	100.2	8.2	0.81
	Totals	682	100.3	0.1	684	8.3	0.0	681	0.82	0.00	5,077,865	100.3	8.3	0.82
3	5/03-5/09	47	104.0	0.7	46	9.7	0.2	46	0.86	0.02	756	104.0	9.7	0.86
3	5/10-5/16	222	105.3	0.3	212	9.6	0.1	212	0.82	0.00	45,508	105.3	9.6	0.82
3	5/17-5/23	252	104.0	0.5	249	9.0	0.1	249	0.82	0.00	944,914	104.0	9.0	0.82
3	5/24-5/30	211	104.1	0.5	211	9.2	0.1	210	0.83	0.01	1,761,446	104.1	9.2	0.83
3	5/31-6/06	117	102.8	0.2	117	9.0	0.1	117	0.83	0.00	1,471,534	102.8	9.0	0.83
3	6/07-6/13	54	104.0	0.5	54	9.1	0.1	54	0.81	0.01	433,554	104.0	9.1	0.81
3	6/14-6/20	10	104.9	2.1	10	9.4	0.7	10	0.80	0.02	29,370	104.9	9.4	0.80
	Totals	913	104.2	0.2	899	9.2	0.0	898	0.82	0.00	4,687,084	103.7	9.1	0.83
4	5/10-5/16	3	121.3	9.4	2	17.7	5.1	2	0.85	0.02	612	121.3	17.7	0.85
	Totals	3	121.3	9.4	2	17.7	5.1	2	0.85	0.02	612	121.3	17.7	0.85

Appendix E.1. Number of young-of-year (YOY) sockeye salmon captured by beach seining standard littoral areas, Red Lake, 1992 and 1993.

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
08-May	0	0	0	0	0					
09-May										
10-May										
11-May										
12-May										
13-May						39	3	215	0	257
14-May										
15-May	0	0	0	0	0					
16-May										
17-May										
18-May										
19-May										
20-May						10	26	1	58	95
21-May	2	47	1	0	50					
22-May										
23-May										
24-May										
25-May										
26-May										
27-May						21	0	15	27	63
28-May										
29-May										
30-May	16	1	0	26	43					
31-May						171	1	4	8	184
01-Jun										
02-Jun										
03-Jun										
04-Jun										
05-Jun	2	0	0	15	17					
06-Jun										
07-Jun										
08-Jun						93	3	2	3	101
09-Jun										
10-Jun										
11-Jun										
12-Jun										
13-Jun	23	2	0	3	28					
14-Jun						44	7	10	16	77
15-Jun										
16-Jun										
17-Jun										
18-Jun										
19-Jun	53	20	0	6	79					
20-Jun										
21-Jun						4	8	5	1	18
22-Jun										
23-Jun										
24-Jun										
25-Jun										

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Appendix E.1. (page 2 of 2)

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
26-Jun										
27-Jun	39	8	5	14	66					
28-Jun										
29-Jun										
30-Jun						52	21	18	1	92
01-Jul										
02-Jul										
03-Jul										
04-Jul	106	6	1	5	118					
05-Jul										
06-Jul										
07-Jul										
08-Jul										
09-Jul										
10-Jul	73	2	20	8	103					
11-Jul										
12-Jul										
13-Jul										
14-Jul										
15-Jul										
16-Jul										
17-Jul	27	2	8	14	51					
18-Jul										
19-Jul										
20-Jul										
21-Jul										
22-Jul										
23-Jul										
24-Jul	24	4	31	[a]	59					

[a] Did not sample due to beach spawning sockeye

Appendix E.2. Average lengths of young-of-year (YOY) sockeye salmon captured by beach seining standard littoral areas, Red Lake, 1992 and 1993.

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
08-May										
09-May										
10-May										
11-May										
12-May										
13-May						32	33	31		32
14-May										
15-May										
16-May										
17-May										
18-May										
19-May										
20-May						30	32	31	34	33
21-May	33	35	35		35					
22-May										
23-May										
24-May										
25-May										
26-May										
27-May						34		32	35	34
28-May										
29-May										
30-May	35	30		35	35	35		36	36	35
31-May										
01-Jun										
02-Jun										
03-Jun										
04-Jun										
05-Jun	32			33	33					
06-Jun										
07-Jun										
08-Jun						36	36	34	36	36
09-Jun										
10-Jun										
11-Jun										
12-Jun										
13-Jun	34	37		36	34					
14-Jun						35	38	35	35	35
15-Jun										
16-Jun										
17-Jun										
18-Jun										
19-Jun	34	40		34	36					
20-Jun										
21-Jun						36	39	35	32	37
22-Jun										
23-Jun										
24-Jun										
25-Jun										

-Continued-

Appendix E.2. (page 2 of 2)

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
26-Jun										
27-Jun	34	39	32	34	35					
28-Jun										
29-Jun										
30-Jun						38	41	33	36	37
01-Jul										
02-Jul										
03-Jul										
04-Jul	36	38	30	34	36					
05-Jul										
06-Jul										
07-Jul										
08-Jul										
09-Jul										
10-Jul	34	36	32	37	34					
11-Jul										
12-Jul										
13-Jul										
14-Jul										
15-Jul										
16-Jul										
17-Jul	31	42	36	38	34					
18-Jul										
19-Jul										
20-Jul										
21-Jul										
22-Jul										
23-Jul										
24-Jul	40	48		39	40					

Appendix E.3. Number of stickleback captured by beach seining standard littoral areas, Red Lake, 1992 and 1993.

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
08-May	0	0	0	78	78					
09-May										
10-May										
11-May										
12-May										
13-May						174	20	86	10	290
14-May										
15-May	1	2	0	0	3					
16-May										
17-May										
18-May										
19-May										
20-May						1,916	139	1,172	2,600	5,827
21-May	1,078	408	26	279	1,791					
22-May										
23-May										
24-May										
25-May										
26-May										
27-May						1,840	0	617	443	2,900
28-May										
29-May										
30-May	1,091	9	0	502	1,602					
31-May						5,535	608	59	415	6,617
01-Jun										
02-Jun										
03-Jun										
04-Jun										
05-Jun	357	34	1	744	1,136					
06-Jun										
07-Jun										
08-Jun						736	882	147	513	2,278
09-Jun										
10-Jun										
11-Jun										
12-Jun										
13-Jun	685	124	0	58	867					
14-Jun						876	661	156	171	1,864
15-Jun										
16-Jun										
17-Jun										
18-Jun										
19-Jun	1,685	805	0	24	2,514					
20-Jun										
21-Jun						10,000[a]	424	126	49	10,599
22-Jun										
23-Jun										
24-Jun										
25-Jun										
26-Jun										
27-Jun	68	178	2	56	304	7,396	38	54	49	7,537
28-Jun										
29-Jun										
30-Jun										
01-Jul										
02-Jul										
03-Jul										
04-Jul	785	192	1	56	1,034					
05-Jul										
06-Jul										
07-Jul										
08-Jul										
09-Jul										
10-Jul	432	250	1	83	766					

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Appendix E.3. (page 2 of 2)

	1992					1993				
Date	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total
11-Jul										
12-Jul										
13-Jul										
14-Jul										
15-Jul										
16-Jul										
17-Jul	894	121	768	95	1,878					
18-Jul										
19-Jul										
20-Jul										
21-Jul										
22-Jul										
23-Jul										
24-Jul	553	501	1,025[a]	[b]	2,079					

[a] Estimated due to heavy algae.
[b] Did not sample due to beach spawning sockeye.

Appendix F.1. Daily climatological observations, water temperature, and water depth monitored at Red Lake field station, 1993.

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
May 5	1945	6	6.5	100		0	30	
6	1900	6.5	8.5	100		0	29	
7	1800	6.5	8.5	90	SW	0-5	30	
8	1800	7	6	90	NW	5-10	30	
9	1800	14	6.5	30	NW	0-5	29	
10	1800	8	5	N/a	SE	10-15	30	Rain
11	1800	15	8	100	SE	5-10	31	Sprinkles
12	1800	12.5	6.5	100	SE	5-10	32	Int. Rain
13	2000	12	7.5	100	SE	0-5	31	
14	1800	17	8	50	NE	0-5	31	Sun
15	1800	34	10	5	NE	0-5	31	Sun
16	1800	12	8	100	SE	0-5	32	
17	1800	9	8	100	W	5-10	31	
18	1800	18	8.5	0	SE	5-10	31	Sun
19	1815	9	9	80	W	10-15	31	
20	1930	11	9	5	NW	15	30	
21	1815	7.5	7	100	S	<5	30	Occasional drizzle
22	1800	9	8	100	N	5	30	
23	1900	8	9.5	100	SE	5-10	31	Occasional drizzle
24	1800	8	9	100	SE	10-15	31	
25	1800	9	7.5	100	SE	5-15	30	
26	1800		7.5	100	SE	5		
27	1800	14	11.5	5	NW	5-10	30	Sun
28	1800	21	9	0	NW	5-10	30	Sun
29	1800	21	11.5	0	NW	5-10	30	Sun
30	1800	24	12	0	W	5	29	Sun
31	1800	16	14.5	0	NW	10-15	29	Sun
June 1	1800	12.5	15.5	75	SW	5-10	29	
2	1800	10	13	100	NE	5-10	29	Rain
3	1800	11.5	12	100			29	Wind lt. and var.
4	1800	12	13	1100	NE	5-10	28	Int. Rain
5	1800	8.5	11	100	E	10-15	29	Rain
6	1800	9	11.5	100	SE	5-10	28	Int. Rain
7	1800	14	12	90	NE	5	28	Int. Rain
8	1800	12	12	100	NE	5-10	28	Int. Rain

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Appendix F.1. (page 2 of 2)

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
9	1800	14	12	50	SW	5-10	27	Sun
10	1800	9	9	100	SW	5-10	27	
11	1800	15	13	50	SW	5	27	Lt. Haze
12	1800	13	11	100	S	0-5	27	Int. Rain
13	1800	13	11.5	100	SW	0-5	27	Int. Rain
14	1900	14	11	50	SW	5-10	27	Sun in afternoon
15	1800	13	11.5	100	NW	5	26	
16	1800	13	12	100	N	5-10	26	Int. Drizzle
17	1800	14	11	100	Calm		26	Heavy rain
18	1900	14	11.5	100	Calm		26	Drizzle
19	1800	15	14.5	10	NW	5-10	25	Lt. Haze
20	1800	19	14	10	W	0-5	25	Thunder heads in afternoon
21	1800	19	16	0	SW	5	25	Sun
22	1900	12	14	100	SE	5	25	Muggy
23	1800	15	14	100	W	0-5	25	
24	1800	23	17	Cavu	NW	0-5	25	Sun
25	1800	19	16	75	Lt & var.		25	
26	1800	12	14	100	SW	5-10	25	Low clouds, fog, rain
27	1800	11	14	100	SE	0-5	24	Int. Rain, fog
28	1800	12	14	100	SE	5	25	Int. Drizzle
29	1800	16	14.5	50	SE	5-10	23	Rdf all day,3500 broken,vis 10-15
30	2000	14.5	13	65	S	0-5	23	Rdf morning, 3500 broken, vis 8, haze

Appendix F.2. Daily climatological observations, water temperature, and water depth monitored at Akalura Lake field station, 1993.

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
May 3	1800			100	SE	20	-	Trap in 18:15
4	1800	8	8	100	Calm	0	30	2000', vis. 20,Drizzle
5	1800	8	6	100	SE	5	36	2000', vis. 20,Drizzle
6	1800	7	9	95	N	20	36	2500', vis. unlmtd, drizzle a.m.
7	1830	6	8	100	SW	10	25	1000', vis. 10, Fog,drizzle
8	1820	7	9	100	NW	15	15	2000', vis. unlmtd
9	1800	4	8	100	SW	20	18	2500', vis. 20
10	1800	4	6	100	SE	35	18	500',Rain,vis <5,snow @500'
11	1830	9	8	100	SE	15	23	2500', vis. 1-10, showers
12	1800	7	8	100	SE	15	23	2000', vis. <5. Rain
13	2000	8	8	100	SE	10	23	Vis <5, periodic drizzle, fog
14	1800	11	9	90	Calm	0	23	Vis 20+, sunny a.m, cloudy p.m.
15	1800	13	9	75	SE	15	23	Vis 20+, sunny a.m.,Cloudy p.m.
16	1800	11	8	100	SE	20 + gusts	23	Vis 10, drizzle a.m., High gusts
17	1930	10	9	100	Calm	0	23	Vis 20+, sunny a.m., Cloudy p.M.
18	1930	10	10	0	SW	10	23	Clear, fog patches
19	1800	12	10	5	W	10	23	Vis 20+, foggy a.m., Sunny p.m.
20	1800	18	11	0	SW	10	20	Cavu all day
21	1800	8	10	100	Calm	0	25	Drizzle & fog
22	1800	8	9	100	SE	5	25	Cloudy all day
23	1800	9	9	100	SE	35 + gusts	20	2000', vis. 5, rain off & on
24	1800	7	9	100	SE	35 + gusts	23	2500', vis. 5, rain off & on
25	1800	7	9	100	SE	35	23	1000', vis. <5, rain
26	1800	8.5	8	100	SE	20	22	1500', vis. 5, light drizzle
27	1800	15	11	50	SE	5-10	20	3500 Brkn,sun, patchy fog
28	1800	16	11.5	0	S	0-5	20	Cavu all day
29	1900	20	13	0	SW	0-5	22	Cavu all day
30	1800	22	14	0	NW	0-10	19	Cavu all day
31	1800	17	11	0	SW	5-10	19	Cavu all day
June 1	1800	12	12	80	SW	15-20	19	1500 Broken, vis 15+
2	1800	10	12	100	SE	0-5 + gusts	19	2000 Solid,3-5 vis, rain
3	1800	12	12	100	SW	10-15	33	3000 Solid,5 vis, int. rain
4	1800	11	11	100	SW	0-10	23	2500 Broken, 10 vis.
5	1930	12	13	80	NE	0-10	20	3000 Broken, 10 vis., int. rain
6	1800	10	11	100	SE	15-25	36	1000 solid, rdf

-Continued-

Appendix F.2. (page 2 of 2)

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
7	1800	10	12	70	SE	10	30	3000, vis 15
8	1800	8	10.5	100	S	10-15	20	2500 solid, 10 vis.
9	1800	13	13	40	SE	10	19	3000 Scattered, cavu
10	1800	11	12	80	S	10	18	3000 broken, cavu
11	1800	14	12	100	S	5	18	3000 solid, vis 5-10
12	1800	11	12	100	NW	0-5	19	2000 Solid, vis 3-5, rdf
13	1800	12	13	100	NW	0-5	15	3000 solid, vis 3-5, rain
14	1800	11	13	70	W	10	15	2500 scattered,vis 15-20
15	1800	15	13	50	W	0-3	15	3500 scattered, vis 20
16	1800	14	12.5	100	SE	15-20	13	3000 solid, vis 10-15, haze,humid
17	1800	13	13	100	E	5-10	20	2500 solid, vis 10
18	1800	12	12	100	N	20	14	2000 Solid, vis 5, rain
19	1800	20	16.5	20	NW	10	13	3500 scattered,vis 25, lt.Haze
20	1800	23	16.5	40	SE	15	15	1000 scattered, cavu
21	1800	20	17	20	SE	20	15	3500 scattered, cavu
22	1800	11	13	80	SE	10	17	3500 Scattered, 20-25 vis
23	1800	15	14	100	NE	0-5	15	3500 broken,vis 20, high overcast
24	1800	15	15	100	E	0-5	11	3500 Solid, vis 10-15
25	1800	16	15	100	SE	0-5	10	3000 solid, vis 10-15
26	1800	11	13	100	SE	30-35	10	500 solid, vis 5, rdf
27	1800	13	14	100	E	0-3	11	1500 Solid, vis 10
28	1800	9	12	100	S	5-10	10	1500 solid, vis 5-10, rdf

Appendix F.3. Daily climatological observations, water temperature, and water depth monitored at Upper Station field station, 1993.

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
May 4	1800	10	9	80		10		Periodic showers
5	1800	11	9	70	E	5	55	Showers & sun all day
6	1800	12	10	30	E	10	55	Partly cloudy all day
7	1800	5	10	70	W	5	55	Periods of showers, overcast
8	1800	7	10	30	NW	15	55	Overcast
9	1800	7	10	30	W	<5	55	Overcast, w/periods of sun
10	1800	4	9	100	E	25-30	61	Overcast, rain
11	1800	8	10	100	E	10	67	Periods of rain
12	1800	8	9	100	E	25	68	Rain all day
13	1800	8	10	100	E	10	67	Lgt. Drizzle & cleared by dark
14	1900	8	10	90	W	5	67	Partly sunny
15	1800	13	11	50	SE	<5	67	Overcast most of day
16	1800	9	10	90	E	35	67	Murky H_2o,stream level stable
17	1800	10	11	90	NW	<5	65	H_2o beginning to clear
18	1800	11	11	10	NW	5	65	
19	1800	11	12	50	NW	5	65	
20	1800	14	12	10	NW	5	65	
21	1800	8	13	100	SE	<5	61	Drizzle all day
22	1800	9	13	100	SE	5	61	
23	1800	9	12	100	E	15	65	Stream guage up due to winds
24	1800	8	11	100	SE	30	68	Rain most of day
25	1900	7	10	100	SE	15	65	Rain & drizzle all day
26	1800	10	10	90	W	10	61	Wind calm by night, clear skies
27	1800	9	11	30	NW	5	61	Day was cavu, fog at night
28	1800	13	12	5	NW	<5	61	Cavu
29	1800	15	14	0	NW	5	61	Cavu
30	1800	22	16	0	NW	5	58	Cavu
31	1800	21	19	5	NW	5	58	Cavu
June 1	1800	12	16	90	SE	10	58	
2	1800	10	14	100	SE	25	58	Rain, wind gusts up to 35
3	1800	11	15	100	SE	5	58	Ceiling 2500' solid
4	1800	8	13	100	SE	10	58	Rain, wind increase to 25 p.m.
5	1800	9	12	100	SE	20	58	Rain, wind decreasing p.m.
6	1800	7	11	100	NE	5	58	Off & on rain showers
7	1800	10	12	90	SE	5-10	61	Rain/wind early in day

-Continued-

Appendix F.3. (page 2 of 3)

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
8	1800	10	12	100	SE	5	61	Alot of algea collecting in trap
9	1800	13	13	35	NW	5	58	Algae increasing in river
10	1800	12	14	40	NW	5	58	
11	1800	11	15	50	NW	5	56	Vegetation increasing in current
12	1800	11	15	100	NW	<5	56	Periods of rain during night
13	1800	10	15	90	N	<5	56	Algae stabalized/ still abundant
14	1800	13	16	50	W	5	56	
15	1800	10	15	85	N	5	56	Algae still flowing down river
16	1930	9	14	95	N	<5	56	NE by evening/ periods of showers
17	1830	9	14	100	NW	5	56	Rain during p.m.
18	1800	13	14	100	NE	5	53	Vegetation still real bad
19	1800	17	16	10	NW	5	53	Sunny all day
20	1800	15	17	20	NW	5	53	Cavu, algea still abundant
21	1740	15	19	20	W	5	51	Algae still abundant
22	1800	11	17	95	E	5	51	Algae still abundant
23	1800	15	16	50	E	5	51	Winds turned W. By eve, calm morning
24	1800	12	16	90	NW	5	51	Rain showers/cleared by night
25	1800	14	18	90	SW	5	51	Rain by daybreak
26	1800	10	15	100	SE	10	51	Lgt.Rain all day
27	1930	10	15	100	SE	5	51	Rain most of day
28	1800	9	15	100	NE	<5	51	Rain
29	1800	12	15	80	NW	5	51	Rain in morning
30	1745	16	15	60	NE	<5	51	Wind 25mph, rain
July 1	1800	12	12	100	SE	25-30	56	Rain
2	1715	13	13	100	SW	5	53	Rain
3	1800	13	13	100	SW	5	53	Periods of rain
4	1800	11	14	90	NW	10	53	Cleared by evening, rain by morning
5	1800	9	13	100	W	5	53	Calm by evening
6	1845	15	14	25	NW	5	53	Cavu
7	1745	13	15	50	NW	5	51	
8	1800	15	16	10	NW	5-10	51	Cavu
9	1800	17	18	5	NW	5	51	Cavu
10	1930	20	19	5	NW	5	51	Cavu
11	1800	16	19	25	W	5	50	Cavu
12	1800	15	19	100	NW	5	48	Trap still fishing well
13	1800	15	19	95	W	5	48	Drizzle & fog
14	1800	11	17	100	SW	5	48	Drizzle

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Appendix F.3. (page 3 of 3)

Date	Time	Temp Air(c)	Temp Water (c)	Cloud Cover %	Wind Dir.	Wind Vel.(Mph)	Stream Guage (1 cm)	Comments
15	1800	16	17	95	W	5	48	Clear by evening
16	1900	17	18	0	NW	5-10	48	Cavu
17	1815	14	19	90	W	5	48	NW Winds & drizzle
18	1930	14	19	90	W	<5	48	Wind blowing se5
19	1735	17	19	5	SE	25-30	50	Cavu
20	1800	19	17	50	SE	10	46	Clear, SE 5 by evening
21	1800	18	18	40	NW	5	46	Vis unlimtd, 100% cloud cover by p.m.
22	1800	14	18	90	W	10	46	
23	1800	17	19	90	W	5	46	Drizzle by evening
24	1800	15	18	100	SE	5	46	On & off drizzle
25	1815	14	17	100	SW	5	46	West winds by daybreak
26	1900	18	18	50	NW	5	46	Clear by evening
27	1800	15	18.5	100	NW	5	46	Rain by evening
28	1800	15	18	100	W	10	46	
29	1800	14	18	100	S	5	46	Clear by evening
30	1800	21	20.5	5	NW	5	46	Cavu
31	1800	20	20	85	W	5	46	
August 1	1800	19	20	60	NW	10	46	SE winds by morning
2	1800	21	20.5	70	NW	5	46	SW winds by morning
3	1810	18	19	90	NW	5	46	
4	1800	17	19	95	NW	5	44	
5	1830	15	19	100	W	5	44	Rdf by evening
6	1800	14	17	100	NW	10	43	Rdf clear by morning
7	1800	19	18	95	NW	5	43	Cavu by morning
8	1800	17	20	0	NW	10	43	Cavu
9	1800	21	21	10	NW	<5	43	Cavu

Appendix F.4. Daily climatological observations, water temperature, and water depth moniored at Frazer Lake field station, 1993.

Date	Time	Temp		Cloud Cover	Wind		Stream Guage	Comments
		Air(c)	Water (c)	%	Dir.	Vel.(Mph)	(1 cm)	
May 8	1800	1	5	95	W	5	42	Very cold night
9	1800	3	5.5	95	NW	5-10	42	Unlimited visibility
10	1800	3	5	100	E	25	42	Rain all day, snow level 1000'
11	1800	7	6	100	N	10	43	Light showers on and off all day
12	1800	8	7	95	E	10	43	Warm night
13	1800	8	6	100	E	5	43	Drizzle
14	1800	20	7	65	E	5	44	Unlimited visibility, hot & sunny
15	1800	15	7	15	E	10	44	Nice day, sunshine
16	1800	7	6	100	E	20	44	Clouds & wind
17	1800	9	7	100	W	10	45	Cloudy
18	1800	12	8	0	E	5	45	Sunshine
19	1800	9	8	5	W	15	45	Sunshine
20	1800	17	9	5	W	5	45	Sunshine
21	1800	8	8	100	E	5	45	Drizzle
22	1800	7	7	100	E	15	45	Cloudy
23	1800	8	6	100	E	10	45	Occasional drizzle
24	1800	6	6	100	E	25	45	Cloudy & windy
25	1800	7.5	6	100	E	5	45	Occasional drizzle
26	1800	8	6	100	E	5	45	Cloudy
27	1800	11	6.5	100	E	10	45	Cloudy
28	1800	22	8	0	W	10	45	Sunny & warm
29	1800	26	10	0	W	10	45	Sunny & warm
30	1800	23	12	0	W	5	45	Sunny & hot
31	1800	20	9.5	0	E	15	45	Sunny but a bit windy
June 1	1800	15	8	80	E	15	45	Cloudy
2	1800	11	6	100	E	5	45	Rain
3	1800	11	6	95	E	10	45	Occasional drizzle/ some sun
4	1800	10	6	100	E	15	45	Gray
5	1800	10	6	95	E	5	45	Occasional drizzle
6	1800	10	7	100	E	20	45	Rain & wind, big storm
7	1800	11	7	100	E	10	45	Cloudy
8	1800	11	6	100	E	15	45	Cloudy
9	1800	11	9	10	W	15	45	Clear
10	1800	11	9	100	W	15	44	Cloudy
11	1800	14	10	100	W	5	44	Cloudy

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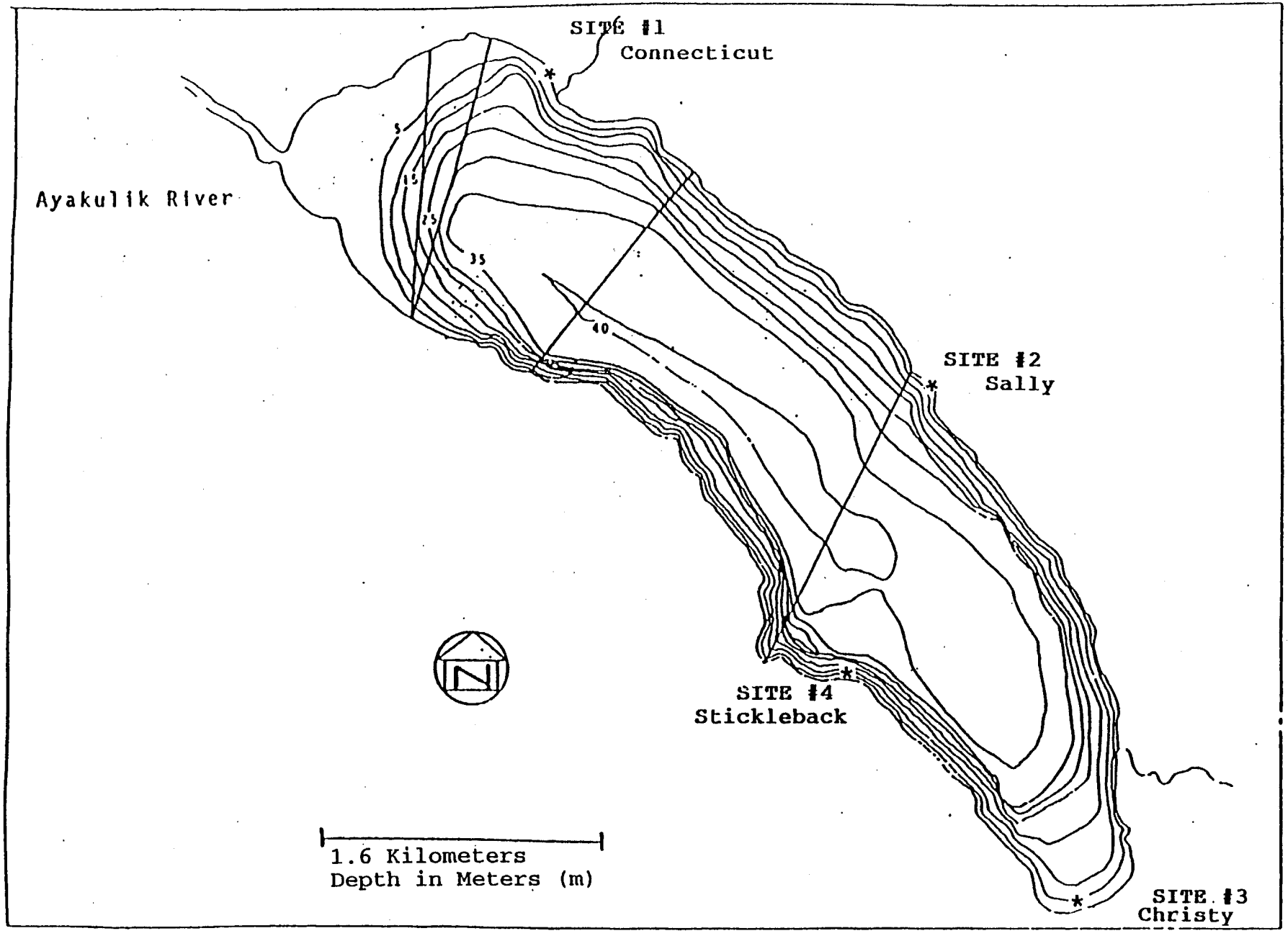
Appendix F.4. (page 2 of 2)

Date	Time	Temp		Cloud Cover %	Wind		Stream Guage (1 cm)	Comments
		Air(c)	Water (c)		Direction	Vel.(Mph)		
12	1800	9	10	100	W	5	43	Rain
13	1800	10	10	100	W	5	44	Light rain
14	1800	13	11	75	S	5	46	Partly cloudy
15	1800	14	10	90	E	10	46	Cloudy
16	1800	12	8	100	E	10	46	Cloudy
17	1800	13	10	100	E	10	46	Cloudy
18	1800	13	10.5	100	W	15	46	Cloudy
19	1800	21	13	15	W	20	47	Clear & warm
20	1800	21	13	30	E	20	47	Partly cloudy
21	1800	15	11.5	90	W	15	46	Mostly cloudy
22	1800	12	10	100	E	25	46	Cloudy



Appendix G.1 Map of Red Lake with littoral zone seine sites identified.

Appendix H.1. Preliminary forecast of the Red River (Ayakulik River) sockeye salmon run, 1994.

Issue Date: 12/08/93

FORECAST AREA: **Kodiak, Ayakulik River (Red River)**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	425	275-575
Escapement Goal	200-300	
Harvest Estimate	175	

FORECAST METHODS:

The 1994 Ayakulik sockeye run forecast represents the sum of six age specific estimates determined from sibling relationships and smolt indices. Age 1.3 fish were estimated from age 1.2 siblings, while age 2.3 return from age 2.2 siblings. Ages 1.1, 1.2, 2.1, and 2.2 returns were estimated from brood year smolt numbers.

The forecast range is a subjective estimate of the 80% confidence interval.

FORECAST DISCUSSION:

The 1994 Ayakulik sockeye run should be about 50% less than the 1993 run and produce a west side terminal catch in the Outer and Inner Ayakulik Sections of about 175,000 fish.

Overall, our confidence in the 1994 Ayakulik run forecast estimate is fair; mainly because most of the estimate is derived from a limited smolt data set.

If the 1994 run materializes as projected, age 2.2 fish will comprise about 70% of the run. Two-ocean age fish should represent about 70% and 3-ocean age fish 30% of the run.

The majority of the 1994 Ayakulik catch should occur in June.

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Appendix H.2. Preliminary forecast of the Upper Station sockeye salmon early run, 1994.

Issue Date: 12/08/93

FORECAST AREA: **Kodiak, Upper Station Lakes**

SPECIES: **Sockeye Salmon**, Early Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	120	90-170
Escapement Goal	50-75	
Harvest Estimate	60	

FORECAST METHODS:

The 1994 Upper Station run forecast is the pooled results of four separate regressions derived from the relationships of age specific returns for post 1978 brood years. The age 1.2 predication was determined from parent escapement; age 1.3 from age 1.2 siblings; age 2.2 from age 2.1 late-run siblings, and age 2.3 from age 2.1 siblings. The forecast range is the sum of the 80% confidence intervals for the four age class estimates.

FORECAST DISCUSSION:

In 1994, there should be about 40% more early run Upper Station fish in the Alitak Bay District than in 1993 providing similar fishing patterns occur on the west side of Kodiak Island and the forecast is accurate. The Altiak Bay District catch of early run Upper Station sockeye salmon should be about 60,000 fish.

The 1994 run is expected to be approximately 75% 2-ocean age fish and 25% 3-ocean age fish. Age 2.2 fish should be dominant, comprising about 70%.

Confidence in the forecast is only fair because the sibling relationships used were generally not strong.
In the Alitak Bay District, the early Upper Station sockeye run extends from early June to mid July; the peak is usually about mid June. Early run Upper Station sockeye salmon are a bycatch component of the targeted fishery on the Frazer Lake sockeye run.

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Appendix H.3. Preliminary forecast of the Upper Station sockeye salmon late run, 1994.

Issue Date: 12/08/93

FORECAST AREA: **Kodiak, Upper Station Lakes**

SPECIES: **Sockeye Salmon,** Late Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	425	300-550
Escapement Goal	150-200	
Harvest Estimate	250	

FORECAST METHODS:

The 1994 Upper Station late run forecast represents the sum of three age specific estimates from regressions equations developed from sibling and escapement-return relationships for the post 1974 brood years and two age specific estimates derived from smolt abundance indices. Age 0.2 return was determined from brood year age 0. smolt numbers; age 0.3 from age 0.2 siblings; age 1.3 from age 1.2 siblings; and age 2.2 from age 1.2 siblings. Age 1.2 return was estimated from brood year age 1. smolt numbers. The forecast range is the approximate 80% confidence interval of the estimate.

FORECAST DISCUSSION:

The 1994 late sockeye run to Upper Station Lakes should be slightly better (10%) than the 1993 run. Two-ocean age fish are expected to comprise 70% of the run, 3-ocean age fish 30%.

Most (50%) of the 1994 Upper Station late run should be age 2.2 fish (5-yr. olds) produced from the 1989 brood year. The age 0.* component should comprise about 30% of the run, which is about average.

The 1994 Upper Station late run forecast is for the Alitak Bay District only; if the fishing patterns and intensity is about the same on the west side of Kodiak Island as in 1993, the expected 1994 harvest in the Alitak Bay District should be about 250,000 late Upper Station fish.

In the Alitak Bay District, the late Upper Station sockeye run extends from mid July to early September and peaks in mid August.

Our confidence in this forecast is fair.

Prepared by: Bruce Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division

Appendix H.4. Preliminary forecast of the Frazer lake sockeye salmon run, 1994.

Issue Date: 12/08/93

FORECAST AREA: **Kodiak, Frazer Lake**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	700	500-900
Escapement Goal	140-200	
Harvest Estimate	525	

FORECAST METHODS:

The 1994 Frazer Lake run forecast represents the sum of four age specific estimates from regression equations developed from sibling relationships for post 1979 brood years and two age specific estimates derived from smolt abundance indices. Age 1.2 return was determined from age 1.1 siblings; age 1.3 from age 1.2 siblings; and age 2.2 from age 2.1 and 1.1 siblings. Age 2.1 and 3. 2 returns were estimated using brood year smolt indices. The forecast range is the 80% confidence interval.

FORECAST DISCUSSION:

The 1994 Frazer Lake run is expected to be slightly better (5%) than the 1993 run. Two-ocean age fish are expected to comprise 50% of the run, 3-ocean age fish 45%.

The 1994 run should be dominated by ages 2.2 (46%) and 2.3 (24%) fish.

The forecasted 1994 run of 700,000 fish is for the Alitak Bay District only. We assume that fishing time and intensity on the west side of Kodiak Island will be about the same as occurred in 1993. If this occurs, the Alitak Bay District catch should be about 525,000 sockeye salmon of Frazer Lake origin.

In the Alitak Bay District, the Frazer Lake run timing is from mid June to mid July; the peak is commonly in late June.

Our confidence in this forecast is fair.

Prepared by: Bruce Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division
